

V1542

REPORT NOS. 208-TRC-91-003
212-TRC-91-003
301-TRC-91-003

VEHICLE SAFETY COMPLIANCE TESTING
FOR OCCUPANT CRASH PROTECTION,
WINDSHIELD MOUNTING, WINDSHIELD ZONE
INTRUSION, AND FUEL SYSTEM INTEGRITY

BAYERISCHE MOTOREN WERKE AG.

1991 BMW 318is

2-DOOR SEDAN

NHTSA NO. CM0503

TRC TEST NO. 901227

THE TRANSPORTATION RESEARCH CENTER OF OHIO

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JANUARY 14, 1991

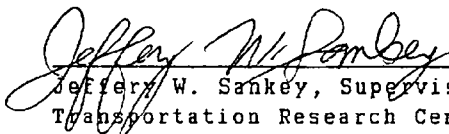
FINAL REPORT

PREPARED FOR:


U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
OFFICE OF VEHICLE SAFETY COMPLIANCE (NEF-31)
400 SEVENTH STREET, S.W., ROOM NO. 6111
WASHINGTON, DC 20590

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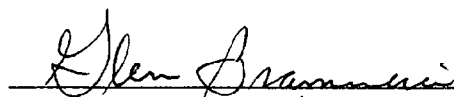
REPORT PREPARED BY:

 Date 1/16/91
Jeffery W. Sankey, Supervisor, Laboratory Engineering
Transportation Research Center of Ohio

REPORT APPROVED BY:

 Date 1-16-91
C. Ray Latimer, Project Manager
Transportation Research Center of Ohio

FINAL REPORT ACCEPTED BY:

 Date 1-31-91
Contracting Officer's Technical Representative (COTR),
NHTSA, Office of Vehicle Safety Compliance

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16. Abstract A 30 mph flat frontal barrier impact test was conducted on a 1991 BMW 318is 2-door sedan, NHTSA No. CM0503, at the Transportation Research Center of Ohio on December 27, 1990. This test was conducted to determine compliance with Federal Motor Vehicle Safety Standards: FMVSS No. 208, "Occupant Crash Protection"; FMVSS No. 212, "Windshield Mounting"; FMVSS No. 219 (partial), "Windshield Zone Intrusion"; FMVSS 301, "Fuel System Integrity." The barrier impact velocity was 29.5 mph. The vehicle's maximum crush was 17.0 inches. The ambient temperature was 70° F. The driver's head injury criteria (HIC) was 431. The driver's maximum chest deceleration over three (3) milliseconds was 61.5 g. The driver's maximum left and right femur forces were 1739 pounds and 2136 pounds, respectively. The passenger's head injury criteria (HIC) was 227. The passenger's maximum chest deceleration over three (3) milliseconds was 35.7 g. The passenger's maximum left and right femur forces were 473 pounds and 613 pounds, respectively. The vehicle appears to comply with the applicable requirements of FMVSS 212, 219 (partial), and 301. The vehicle's data indicated an apparent noncompliance with the requirements of FMVSS 208.			
17. Key Words Frontal Impact 30 mph Vehicle Safety Compliance Testing: FMVSS 208, "Occupant Crash Protection" FMVSS 212, "Windshield Mounting" FMVSS 219P, "Windshield Zone Intrusion" FMVSS 301, "Fuel System Integrity"		18. Distribution Statement Available from: NHTSA Technical Reference Division Room 5108, (NAD-52) -400 Seventh Street, SW Washington, DC 20590 Attn: Mr. Robert Hornickie	
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SECTION 1.0

PURPOSE & TEST PROCEDURE

PURPOSE

This 30 mph flat frontal barrier impact test is part of the Federal Motor Vehicle Safety Standard (FMVSS) 208, 212, 219 (partial), and 301 compliance test program conducted for the National Highway Traffic Safety Administration (NHTSA) by the Transportation Research Center of Ohio (TRC) under Contract No. DTNH22-90-C-21003. The purpose of this test was to determine if the subject vehicle, a 1991 BMW 318is 2-door sedan, NHTSA No. CM0503, meets the performance requirements of FMVSS 208, "Occupant Crash Protection"; FMVSS 212, "Windshield Mounting"; FMVSS 219 (partial), "Windshield Zone Intrusion"; and FMVSS 301, "Fuel System Integrity," in the flat frontal barrier impact mode.

TEST PROCEDURE

This test was conducted in accordance with NHTSA's Office of Vehicle Safety Compliance (OVSC) Laboratory Test Procedure No. TP-208-08. Data was obtained relative to FMVSS 208, "Occupant Crash Protection"; FMVSS 212, "Windshield Mounting"; FMVSS 219 (partial), "Windshield Zone Intrusion"; and FMVSS 301, "Fuel System Integrity," performance.

The test vehicle was instrumented with seven (7) accelerometers to measure longitudinal axis accelerations. The vehicle's specified impact velocity range was 28.9 to 29.9 mph. The vehicle impacted a flat frontal barrier.

The test vehicle contained two (2) Part 572 B 50th percentile adult male anthropomorphic test devices (dummies). The dummies were positioned in the front outboard designated seating positions according to the dummy placement procedure specified in Appendix B and Appendix C of the Laboratory Test Procedure.

Both dummies were instrumented with head and chest accelerometers to measure longitudinal, lateral, and vertical accelerations, and with left and right femur load cells to measure axial forces.

The twenty-three (23) data channels were multiplexed and recorded on a 14-track tape drive. The data was digitally sampled at 8000 samples per second and processed per sections 12.8 and 12.9 of the Laboratory Test Procedure.

The crash event was recorded by one (1) real-time panning motion picture camera and fourteen (14) high-speed motion picture cameras. The pre-test and post-test conditions were recorded by one (1) real-time motion picture camera.

The vehicle and occupant data are summarized in Section 2.0. The FMVSS 208, 212, 219 (partial) and 301 data are presented in Section 3.0. The vehicle, occupant, and camera measurements are presented in Section 4.0. Appendix A contains the still photographic prints. Appendix B contains the dummy and vehicle data plots.

SECTION 2.0

FRONTAL BARRIER IMPACT TEST SUMMARY

TEST RESULTS SUMMARY

This flat frontal barrier test was conducted at TRC on December 27, 1990.

The test vehicle, a 1991 BMW 318is 2-door sedan, NHTSA No. CM0503, appeared to comply with the performance requirements of FMVSS test Nos. 212, 219 (partial), and 301 in the flat frontal barrier impact mode. The vehicle's data indicated an apparent noncompliance with the FMVSS test No. 208 requirements. For the Part 572 B dummy seated in the left front outboard designated seating position, the Head Injury Criteria (HIC) calculation was less than 1000 and the compressive forces transmitted through the upper legs did not exceed 2,250 pounds as measured. The chest resultant acceleration exceeded 60 g's. For the Part 572 B dummy seated in the right front outboard designated seating position, the Head Injury Criteria (HIC) calculation was less than 1000, the chest resultant acceleration did not exceed 60 g's and the compressive forces transmitted through the upper legs did not exceed 2,250 pounds as measured. The vehicle's restraint system met the applicable comfort and convenience requirements. The windshield periphery retention was 100 percent. There was no penetration into any portion of the windshield. No fluid spilled from the vehicle's fuel system following the impact. Due to the apparent noncompliance the static rollover test was not conducted.

The test vehicle was equipped with a 1.8 liter, inline engine, manual transmission, and power brakes. The vehicle's test weight was 3169 pounds. The vehicle's impact speed was 29.5 mph. The vehicle's maximum crush was 17.0 inches.

The driver's head injury criteria (HIC) was 431. The driver's maximum chest resultant acceleration over three (3) milliseconds was 61.5 g. The driver's maximum left and right femur forces were 1739 pounds and 2136 pounds, respectively.

The right front passenger's HIC was 227. The right front passenger's maximum chest resultant acceleration over three (3) milliseconds was 35.7 g. The right front passenger's maximum left and right femur forces were 473 pounds and 613 pounds, respectively.

There was no loss of windshield periphery retention.

There was no intrusion through the windshield.

There was no fluid spillage from the vehicle's fuel system following the crash test event.

TABLE 1 CRASH TEST SUMMARY

NHTSA NO.: CM0503 TEST TYPE: Frontal Barrier Impact

TEST DATE: 12/27/90 TEST TIME: 1149 AMBIENT TEMP. (°F): 70

VEHICLE YEAR/MAKE/MODEL/BODY STYLE: 1991 BMW 318is 2-door sedan

VEHICLE TEST WEIGHT (LBS): 3169

IMPACT ANGLE (DEG)*: 0

IMPACT VELOCITY (MPH)**: PRIMARY = 29.5 SECONDARY = 29.5

MAXIMUM STATIC CRUSH (IN): 17.0

AVERAGE REBOUND (IN): 2.8

DUMMIES: Driver #1173 Passenger #353

TYPE: Part 572 B Part 572 B

LOCATION: Left front Right front

RESTRAINT: Airbag 3-point unbelt

NUMBER OF DATA CHANNELS: 23

NUMBER OF CAMERAS: HIGH-SPEED 14 REAL-TIME 2

*With respect to tow track centerline.

**Speed trap measurement (\pm .05 mph accuracy)

TABLE 2 TEST VEHICLE INFORMATION

VEHICLE MANUFACTURER: Bayerische Motoren Werke Ag.

MAKE/MODEL: BMW 318is

VIN: WBAAF9312MEE71524

BODY STYLE: 2-door sedan

MODEL YEAR: 1991

NHTSA NO.: CM0503

COLOR: Silver

ENGINE DATA: TYPE: inline

CYLINDERS: 4

DISPLACEMENT: 1.8 liter

TRANSMISSION DATA: 5 SPEED, X MANUAL, AUTOMATIC, FWD, X RWD, 4WD

DATE VEHICLE RECEIVED: 12/10/90

ODOMETER READING: 62

DEALER'S NAME AND ADDRESS: Mid-Ohio Imports

4050 Morse Road

Columbus, OH 43230

ACCESSORIES:

POWER STEERING No

AUTOMATIC TRANSMISSION No

POWER BRAKES Yes

AUTOMATIC SPEED CONTROL No

POWER SEATS No

TILTING STEERING WHEEL No

POWER WINDOWS Yes

TELESCOPING STEERING WHEEL No

TINTED GLASS Yes

AIR CONDITIONING Yes

RADIO Yes

ANTI-SKID BRAKE Yes

CLOCK Yes

REAR WINDOW DEFROSTER Yes

OTHER Sunroof, fog lights

REMARKS:

1. IS THE VEHICLE STOCK THROUGHOUT? Yes
2. DOES VEHICLE SHOW EVIDENCE OF PRIOR ACCIDENT HISTORY? No
3. DOES VEHICLE SHOW ANY SIGNIFICANT CORROSION? No
4. CONDITION OF THE FRONT/REAR BUMPER AND FRAME: Good

CERTIFICATION DATA FROM VEHICLE'S LABEL:

VEHICLE ALTERED BY: Bayerische Motoren Werke Ag.

DATE OF MANUFACTURE: 10-90

VIN: WBAAF9312MEE71524

GVWR: 3571 LBS

GAWR: FRONT: 1698 LBS., REAR: 1940 LBS.

TABLE 2 TEST VEHICLE INFORMATION CONT'D

TIRES ON VEHICLE (MFR., LINE, SIZE): Goodyear Eagle 195/65R14

TIRE PRESSURE WITH MAXIMUM CAPACITY VEHICLE LOAD: FRONT: 44 PSI
REAR: 44 PSI

SPARE TIRE (MFR., LINE, SIZE): Goodyear Eagle 195/65R14

TYPE OF SEATS: FRONT: Bucket
REAR: Bench

TYPE OF FRONT SEAT BACKS: Manual adjustable

MAXIMUM WIDTH: 65.0 INCHES

WHEELBASE: 101.0 INCHES

LOCATION OF LABEL STATING TIRE & CAPACITY DATA: THE LABEL WAS LOCATED ON
THE LOWER PORTION OF THE DRIVER'S B-PILLAR.

TIRE & CAPACITY DATA FROM VEHICLE'S LABEL:

RECOMMENDED TIRE SIZE: P195/65R14

RECOMMENDED COLD TIRE PRESSURE: FRONT: 28 PSI; REAR: 30 PSI

DESIGNATED SEATING CAPACITY: 2 FRONT 3 REAR 5 TOTAL

VEHICLE CAPACITY WEIGHT: 970 LBS.

TEST VEHICLE ATTITUDE (ALL MEASUREMENTS ARE IN INCHES):

DELIVERED ATTITUDE:	LF	26.2;	RF	26.0;	LR	24.8;	RR	24.8
FULLY LOADED ATTITUDE:	LF	26.0;	RF	26.0;	LR	23.1;	RR	23.1
PRE-TEST ATTITUDE:	LF	26.0;	RF	26.0;	LR	24.4;	RR	24.5
POST-TEST ATTITUDE:	LF	25.8;	RF	29.0;	LR	22.9;	RR	22.8

TABLE 2 TEST VEHICLE INFORMATION CONT'D

WEIGHT OF TEST VEHICLE AS RECEIVED (WITH MAXIMUM FLUIDS):

RIGHT FRONT	710 LBS.	RIGHT REAR	616 LBS.
LEFT FRONT	676 LBS.	LEFT REAR	633 LBS.
TOTAL FRONT WEIGHT	1386 LBS.	(52.6% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	1249 LBS.	(47.4% OF TOTAL VEHICLE WEIGHT)	
TOTAL DELIVERED WEIGHT 2635 LBS.			

CALCULATION OF TEST VEHICLE'S TARGET TEST WEIGHT:

RCLW = RATED CARGO AND LUGGAGE WEIGHT*

UDW = UNLOADED DELIVERED WEIGHT (2635 LBS)

VCW = VEHICLE CAPACITY WEIGHT (970 LBS)

DSC = DESIGNATED SEATING CAPACITY (5)

$RCLW* = VCW - 150 (DSC) = 970 - 150 (5) = 220$

TARGET TEST WEIGHT = UDW + RCLW* + (NO. OF HYBRID II DUMMIES X 164 LBS/DUMMY)

TARGET TEST WEIGHT = 2635 + 220 + 328

TARGET TEST WEIGHT = 3183 LBS

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 206 LBS. OF CARGO WEIGHT:

RIGHT FRONT	740 LBS.	RIGHT REAR	833 LBS.
LEFT FRONT	764 LBS.	LEFT REAR	832 LBS.
TOTAL FRONT WEIGHT	1504 LBS.	(47.5% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	1665 LBS.	(52.5% OF TOTAL VEHICLE WEIGHT)	
TOTAL TEST WEIGHT	3169 LBS.	(0.9% UNDER TARGET TEST WEIGHT)	

WEIGHT OF BALLAST SECURED IN VEHICLE CARGO AREA: 150 LBS.

COMPONENTS REMOVED TO MEET TARGET TEST WEIGHT: None

CG = 53.1 INCHES REARWARD OF FRONT WHEEL CENTERLINE

*Cargo weight for multi-purpose passenger vehicles, trucks, and buses is the vehicle's rated cargo and luggage weight from the vehicle's label or 300 pounds, whichever is less.

TABLE 3 POST-IMPACT DATA

TEST NUMBER: 901227 NHTSA NO.: CM0503
TEST DATE: 12/27/90 TEST TIME: 1149
TEST TYPE: Frontal Barrier Impact IMPACT ANGLE: 0
AMBIENT TEMPERATURE AT IMPACT AREA: 70° F
TEMPERATURE IN OCCUPANT COMPARTMENT: 70° F
IMPACT VELOCITY: PRIMARY = 29.5 MPH SECONDARY = 29.5 MPH
(SPECIFIED RANGE = 28.9 TO 29.9 MPH)
DISTANCE FROM VEHICLE TO BARRIER: ENTERING VELOCITY TRAP = 26.0 IN.
EXITING VELOCITY TRAP = 2.0 IN.

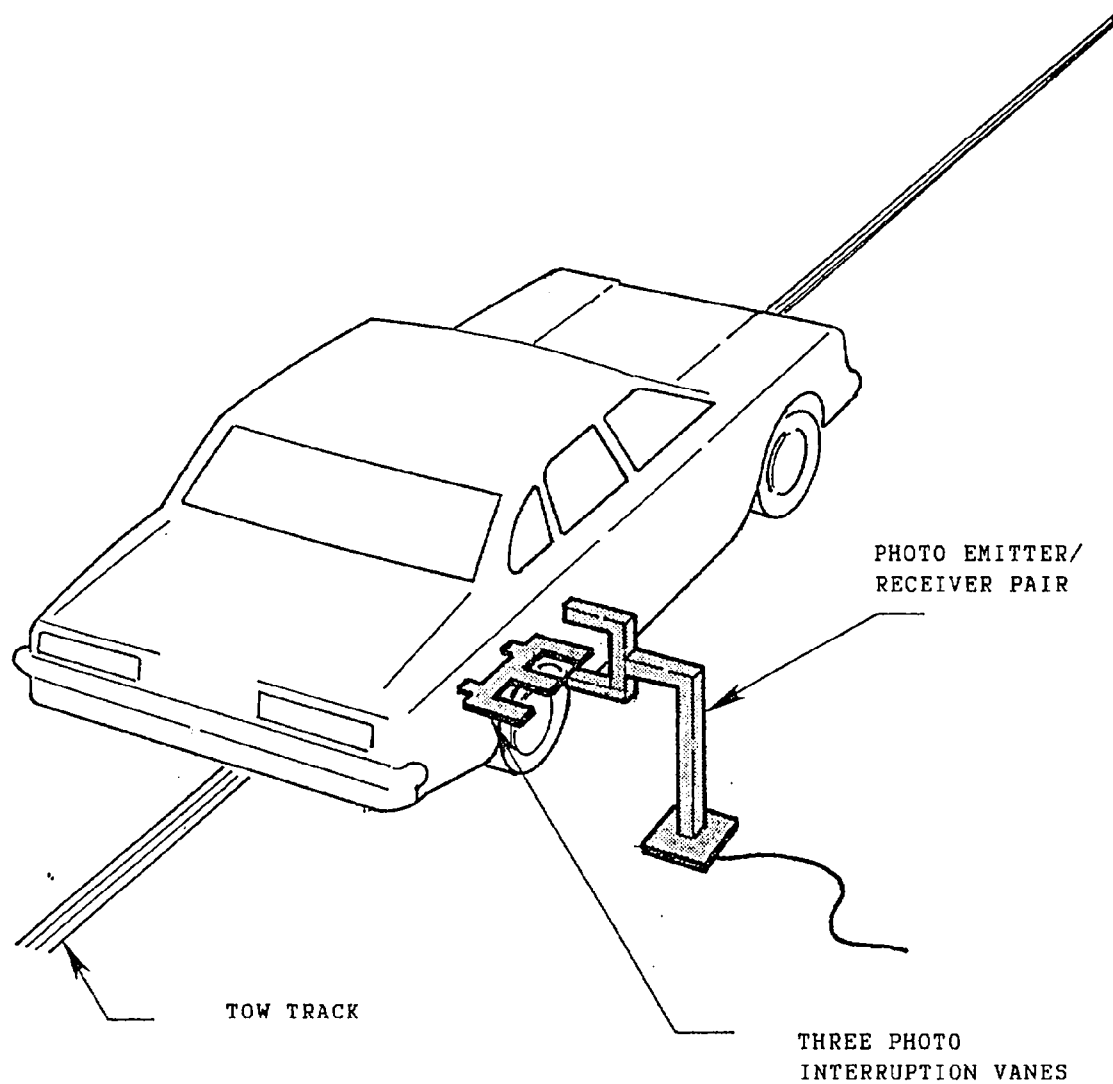
TEST VEHICLE STATIC CRUSH (ALL MEASUREMENTS ARE IN INCHES):

OVERALL LENGTH OF TEST VEHICLE: PRE-TEST: L 165.5 ;C 169.8 ;R 165.8
POST-TEST: L 150.2 ;C 152.8 ;R 150.5
TOTAL CRUSH: L 15.3 ;C 17.0 ;R 15.3
AVERAGE CRUSH: 15.9

TEST VEHICLE REBOUND FROM FLAT BARRIER (ALL MEASUREMENTS ARE IN INCHES):

DISTANCE FROM TEST VEHICLE TO BARRIER: L 3.9; C 1.6; R 3.0; AVG. 2.8

FIGURE 1 IMPACT VELOCITY MEASUREMENT SYSTEM



The final vane clears emitter/receiver two inches before impact.

The vanes have one foot spacing.

FIGURE 2 ACCIDENT INVESTIGATION DIVISION DATA
FOR 30 MPH FRONTAL BARRIER IMPACT

VEHICLE MAKE/MODEL/BODY STYLE: BMW 318is 2-door sedan

VEHICLE NHTSA NO.: CM0503; VIN: WBAAF9312MEE71524

MODEL YEAR: 1991; BUILD DATE: 10/90; TEST DATE: 12/27/90

VEHICLE SIZE CATEGORY: Subcompact; TEST WEIGHT: 3169 LBS.

VEHICLE WHEELBASE: 101.0 INCHES

MAXIMUM WIDTH: 65.0 INCHES

FRONT OVERHANG: 29.8 INCHES

COLLISION DEFORMATION
CLASSIFICATION (CDC) CODE: 12FDEW3

CRUSH DEPTH
MEASUREMENTS:

C1 = 15.3 INCHES

C2 = 16.2 INCHES

C3 = 16.7 INCHES

C4 = 17.0 INCHES

C5 = 16.5 INCHES

C6 = 15.3 INCHES

MIDPOINT OF DAMAGE: D = $\frac{\text{VEHICLE CENTERLINE}}{\text{(LONGITUDINAL)}}$

LENGTH OF DAMAGED
REGION:

L = 58.0 INCHES

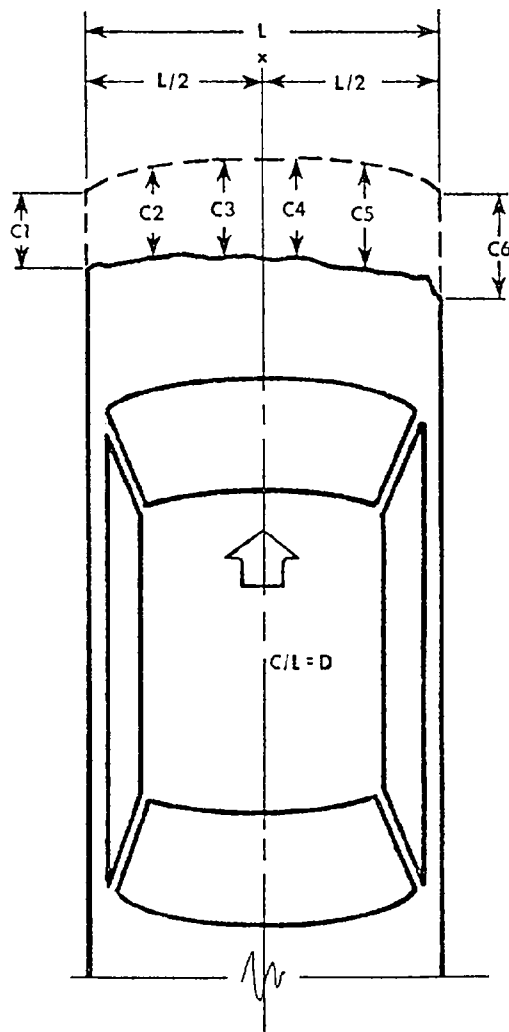
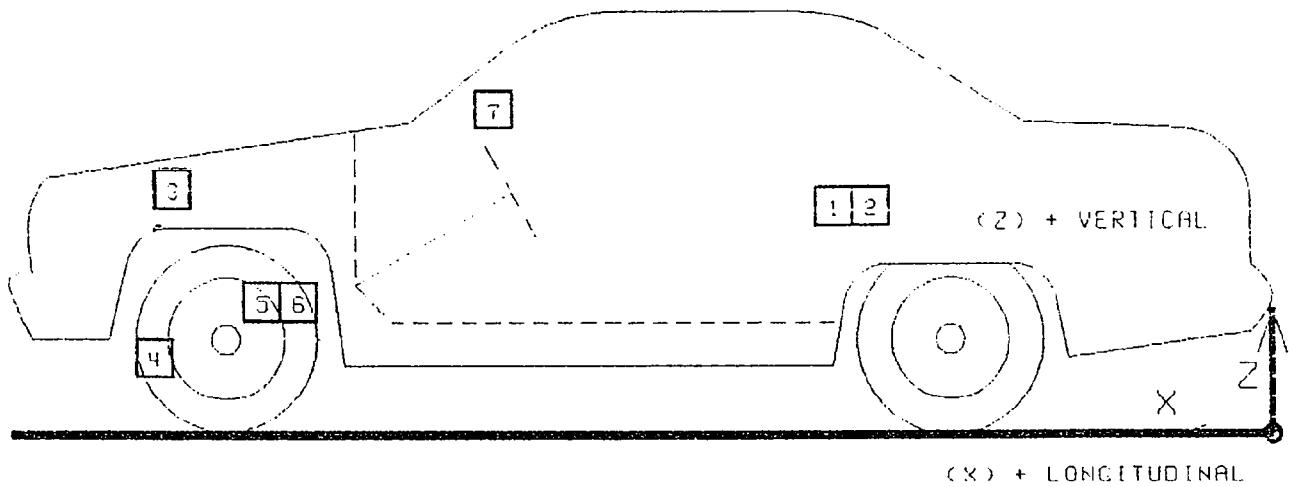
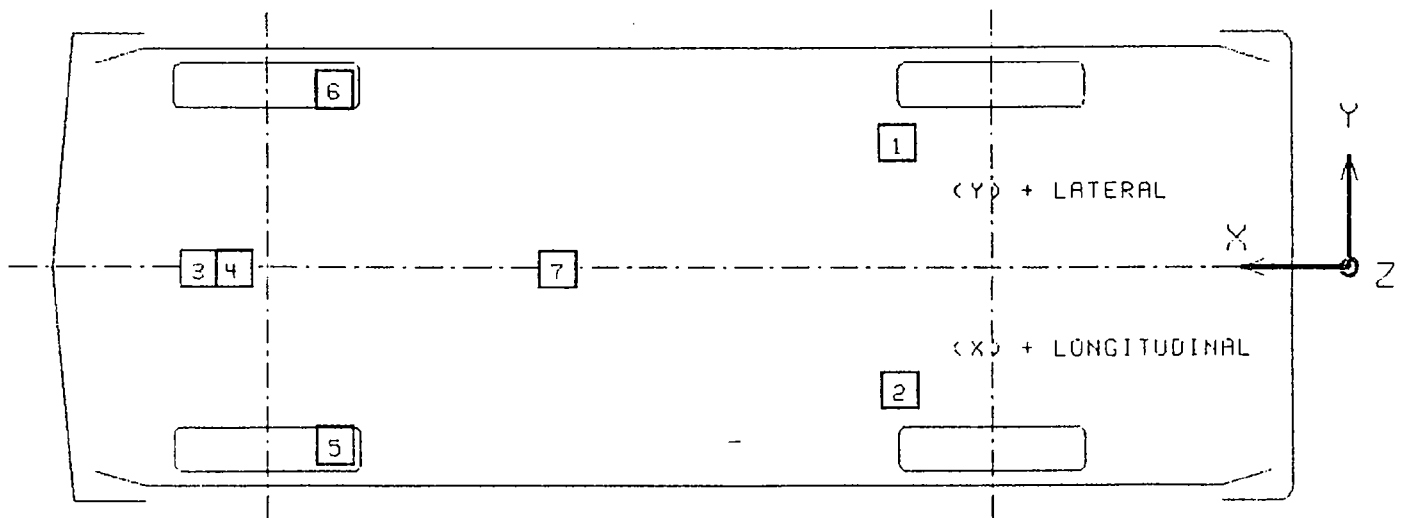


FIGURE 3
VEHICLE ACCELEROMETER PLACEMENT



SIDE VIEW



BOTTOM VIEW

TABLE 4
VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

TEST NUMBER 901227

No.	LOCATION		X*	Y*	Z*	POSITIVE DIRECTION		NEGATIVE DIRECTION	
						MAX	G MSEC	MAX	G MSEC
1	LEFT REAR SEAT CROSSMEMBER LONGITUDINAL	PRE	66.6	24.2	15.0				
		POST	67.5	24.2	15.0				
						1.4	161.3	36.2	45.3
2	RIGHT REAR SEAT CROSSMEMBER LONGITUDINAL	PRE	66.6	-24.1	14.0				
		POST	66.5	-24.1	15.0				
						1.8	153.4	36.8	47.1
3	ENGINE TOP LONGITUDINAL	PRE	139.0	-6.8	31.8				
		POST	131.4	-7.1	34.0				
						18.4	42.0	125.7	34.6
4	ENGINE BOTTOM LONGITUDINAL	PRE	148.5	2.0	6.0				
		POST	145.0	1.4	10.8				
						58.8	41.8	107.9	35.4
5	RIGHT BRAKE CALIPER LONGITUDINAL	PRE	136.5	-23.5	11.0				
		POST	134.5	-18.5	9.6				
						40.9	59.0	58.9	31.6
6	LEFT BRAKE CALIPER LONGITUDINAL	PRE	137.0	23.5	11.1				
		POST	135.2	19.0	9.9				
						49.8	61.0	58.5	43.9
7	INSTRUMENT PANEL CENTER LONGITUDINAL	PRE	114.6	2.0	37.5				
		POST	115.0	3.0	37.1				
						21.8	66.9	46.3	51.3

* ALL MEASUREMENTS OF ACCELEROMETER LOCATIONS ARE IN INCHES.

REFERENCE: X: + FORWARD FROM REAR BUMPER
Y: + LEFTWARD FROM VEHICLE CENTERLINE
Z: + UPWARD FROM GROUND LEVEL

REPORT OF VEHICLE CONDITION AT THE
COMPLETION OF TESTING

CONTRACT NO.: DTNH22-90-C-21003
FROM: The Transportation Research Center of Ohio
10820 State Route 347
East Liberty, OH 43319

TO: Mr. Glen Brammeier
COTR
Office of Vehicle Safety Compliance

The following vehicle has been subjected to testing for FMVSS 208. The vehicle was inspected upon arrival at the laboratory for the test and found to contain all of the equipment listed below. All variances have been reported within 2 working days of vehicle arrival, by letter, to the NHTSA Industrial Property Manager/NAD-30, with a carbon copy to the responsible testing office. The vehicle is again inspected, after the above test has been conducted, and all changes are noted below. The final condition of the vehicle is also noted in detail.

NHTSA NO.: CM0503
MAKE/MODEL/BODY STYLE: BMW/318is/2-door sedan
MODEL YEAR: 1991 BODY COLOR: Silver
VIN: WBAAF9312MEE71524
ODOMETER (ARRIVAL): 62 DATE: 12/10/90
ODOMETER (COMPLETION): 67 DATE: 12/27/90
COST: \$20,975.00

<input checked="" type="checkbox"/> AIR CONDITIONER	<input checked="" type="checkbox"/> CONSOLE	BRAKES: <input checked="" type="checkbox"/> POWER
<input checked="" type="checkbox"/> TINTED GLASS	<input checked="" type="checkbox"/> TACHOMETER	FRONT: Disc
<input type="checkbox"/> POWER STEERING	<input checked="" type="checkbox"/> SPEED CONTROL	REAR: Disc
<input checked="" type="checkbox"/> POWER WINDOWS	<input checked="" type="checkbox"/> REAR WINDOW DEF.	
<input checked="" type="checkbox"/> POWER DOOR LOCKS	<input checked="" type="checkbox"/> SUN/MOON ROOF	FRONT SEATS: <input type="checkbox"/> POWER
<input checked="" type="checkbox"/> RADIO AM/FM TAPE	<input type="checkbox"/> T-TOP	SEAT TYPE: Bucket
<input checked="" type="checkbox"/> CLOCK	<input type="checkbox"/> TILT STEERING WHEEL	NO. OF SEATS: 5
<input type="checkbox"/> ROOF RACK	<input checked="" type="checkbox"/> OTHER OPTIONS: <u>Sun roof</u>	
	<u>Fog lights</u>	

ENGINE: 4 CYLINDERS; 1.8 LITERS
TRANSMISSION: 5-speed manual; DRIVE TYPE: Rear
TIRE SIZE: P195/65HR14
GASOLINE TYPE: Unleaded

EQUIPMENT THAT IS NO LONGER ON THE VEHICLE AS NOTED ABOVE: None

EXPLANATION: NA

VEHICLE CONDITION: Vehicle was subjected to a 30 mph frontal impact
test.

SECTION 3.0

FMVSS 208, 212, 219 (partial), & 301 DATA

TABLE 5 DUMMY INJURY CRITERIA

MAXIMUM ACCELERATION (G)

	HEAD				CHEST			
	X	Y	Z	R	X	Y	Z	R*
DRIVER	-68.5	8.9	-38.2	70.0	-62.5	5.3	-12.4	61.5
PASSENGER	-27.6	-15.5	-36.8	42.8	-40.2	-15.6	16.0	35.7

MAXIMUM FEMUR COMPRESSIVE FORCE (LBS)

	LEFT FEMUR	RIGHT FEMUR
DRIVER	1739	2136
PASSENGER	473	613

HEAD INJURY CRITERIA**

	HIC	TIME t_1 (MSEC) ¹	TIME t_2 (MSEC) ²
DRIVER	431	66.8	87.5
PASSENGER	227	56.6	92.6

*Defined as exceeding 0.003 sec. duration

**As defined in FMVSS No. 208

TABLE 6 POST-IMPACT DUMMY/VEHICLE DATA

VISIBLE DUMMY CONTACT POINTS:

	DRIVER #1173	PASSENGER #353
HEAD	<u>Sunvisor & airbag</u>	<u>Chest</u>
CHEST	<u>Airbag</u>	<u>None</u>
ABDOMEN	<u>None</u>	<u>None</u>
LEFT KNEE	<u>Instrument panel</u>	<u>Instrument panel</u>
RIGHT KNEE	<u>Instrument panel</u>	<u>Instrument panel</u>

DOOR OPENING:

	LEFT	RIGHT
FRONT	<u>Easy</u>	<u>Easy</u>
REAR	<u>NA</u>	<u>NA</u>

SEAT MOVEMENT:

	SEAT BACK FAILURE	SEAT SHIFT
FRONT	<u>None</u>	<u>Passenger's seat shifted forward</u>
REAR	<u>NA</u>	<u>NA</u>

GLAZING DAMAGE:

The right portion of the windshield was cracked upon impact.

OTHER NOTABLE IMPACT EFFECTS:

None

DUMMY KINEMATIC SUMMARY

Driver Dummy

Upon impact, the driver dummy translated forward on the seat impacting both knees into the instrument panel. The dummy's head contacted the sunvisor as the dummy's head and chest were restrained by the driver's airbag. The dummy's head rotated forward and then rearward as the dummy rebounded into the seat back. The dummy came to rest seated in the driver's seat.

Right Front Passenger Dummy

Upon impact, the right front passenger dummy translated forward on the seat impacting both knees into the instrument panel. The dummy's head rotated forward, contacting the dummy's chest, as the dummy's torso was restrained by the three-point unbelt. The dummy's head rotated rearward as the dummy rebounded into the seat back. The dummy came to rest seated in the right front passenger's seat, restrained by the three-point unbelt.

TABLE 7 FMVSS 208 COMFORT AND CONVENIENCE DATA FOR MANUAL SEAT BELTS

MAKE/MODEL: BMW/318is

VIN: WBAAF9312MEE71524

BODY STYLE: 2-door sedan

NHTSA NO.: CM0503

DATE OF MANUFACTURE: 10/90

WEBBING TENSION - RELIEVING DEVICE:

DO OUTBOARD SEATING POSITION SEAT BELTS HAVE WEBBING TENSION - RELIEVING DEVICES? No

BELT CONTACT FORCE:

BELT CONTACT FORCE ON CHEST OF TEST DUMMY: .2 POUNDS

LATCHPLATE ACCESS:

ARE THE SEAT BELT LATCHPLATES, IN THEIR NORMAL STOWED POSITION, WITHIN THE REACH ENVELOPE? Yes

DOES THE CLEARANCE TEST BLOCK MOVE UNHINDERED TO THE LATCHPLATE OR BUCKLE? Yes

RETRACTION:

SEAT BELT AUTOMATICALLY RETRACTS WHEN

(check one): The adjacent vehicle door is open and the seat belt latchplate is released.

 X The seat belt latchplate is released.

ARE THE STOWED SEAT BELT WEBBING AND HARDWARE PINCHED WHEN THE DOOR IS CLOSED? No

ACCESSIBILITY:

IS THE SEAT CUSHION REMOVABLE SO THE SEAT BACK SERVES A FUNCTION OTHER THAN SEATING? No

IS THE SEAT REMOVABLE? No

IS THE SEAT MOVABLE SO THE SPACE FORMERLY OCCUPIED BY THE SEAT CAN BE USED FOR A SECONDARY FUNCTION? No

TABLE 7 FMVSS 208 COMFORT AND CONVEN. DATA FOR MANUAL SEAT BELTS. CONT'D

MAKE/MODEL: BMW/318is

VIN: WBAAF9312MEE71524

BODY STYLE: 2-door sedan

NHTSA NO.: CM0503

DATE OF MANUFACTURE: 10/90

NOTE: IF ANY OF THE ABOVE ANSWERS ARE "YES", THE ACCESSIBILITY REQUIREMENTS DO NOT APPLY.

IF WEBBING IS DESIGNED TO PASS THROUGH THE SEAT CUSHION OR BETWEEN THE CUSHION AND SEAT BACK ARE ONE OF THE FOLLOWING PARTS NORMALLY ON TOP OF OR ABOVE THE SEAT CUSHION: LATCHPLATE, BUCKLE, WEBBING? NA,
Webbing is not designed to pass through the seat cushion or between the cushion and seat back.

ARE THE REMAINING TWO PARTS ACCESSIBLE UNDER NORMAL CONDITIONS: NA
Webbing is not designed to pass through the seat cushion or between the cushion and seat back.

DO THE LATCHPLATE AND BUCKLE PASS THROUGH THE GUIDES PROVIDED AND FALL BEHIND THE SEAT WHEN THE BELT IS COMPLETELY RETRACTED (OR DETACHED IF NOT RETRACTABLE); THE SEAT IS MOVED TO ANY POSITION; AND THE SEAT BACK, IF FOLDABLE, IS FOLDED FORWARD AS FAR AS POSSIBLE AND THEN MOVED BACKWARD INTO POSITION? No

IS THE INBOARD RECEPTACLE END OF THE OUTBOARD SEATING POSITION'S SEAT BELT ACCESSIBLE WITH THE CENTER ARM REST IN ANY POSITION TO WHICH IT CAN BE ADJUSTED WITHOUT MOVING THE ARM REST FOR ACCESS? NA, The vehicle does not include a center arm rest.

TABLE 8 FMVSS 208 SEAT BELT WARNING SYSTEM DATA

WITH OCCUPANT IN DRIVER'S POSITION AND UNIBELT IN STOWED POSITION AND
IGNITION SWITCH PLACED IN "START/ON" POSITION:

Duration of audible warning signal = 6 sec.

Duration of reminder light operation = 6 sec.

WITH OCCUPANT IN DRIVER'S POSITION AND UNIBELT IN USE AND THE IGNITION
SWITCH PLACED IN "START/ON" POSITION:

Duration of audible warning signal = 0 sec.

(NOTE: audible warning should not operate)

Duration of reminder light operation = 6 sec.

WORDING OF VISUAL WARNING:

Fasten Seat Belt

Fasten Belt

Symbol 101-80 X

TABLE 9 FMVSS 208 LABELING AND DRIVER'S MANUAL DATA

DESCRIBE LOCATION OF LABEL WHICH DESCRIBES MANUFACTURER'S MAINTENANCE OR REPLACEMENT SCHEDULE FOR CRASH-DEPLOYED OCCUPANT PROTECTON SYSTEM:

The label is located inside the glove box..

THE MANUFACTURER'S RECOMMENDED SCHEDULE IS TO: (check one)

X check, replace _____ or repair _____ this system: (check one)

a. by _____ month, _____ year

b. by _____ miles

c. or after a time interval of _____ months or 3 years.

WERE APPROPRIATE INSTRUCTIONS CONCERNING MAINTENANCE AND/OR REPLACEMENT OF THIS SYSTEM PROVIDED? Yes Owner's manual, page 15

WAS A DESCRIPTION OF THE FUNCTIONAL OPERATION OF THE SYSTEM PROVIDED?
Yes, Owner's manual, page 15

IS THERE A REFERENCE TO THE INSTRUCTIONS AND DESCRIPTION OF THE SYSTEM ON THE LABEL? Yes

WAS AN OWNER'S MANUAL PROVIDED? Yes

DID THE OWNER'S MANUAL CONTAIN APPROPRIATE INFORMATION CONCERNING MAINTENANCE AND/OR REPLACEMENT AND A DESCRIPTION OF THE FUNCTIONAL OPERATION OF THE SYSTEMS? Yes, page 15

TABLE 10 FMVSS 208 READINESS INDICATOR DATA

AN OCCUPANT RESTRAINT SYSTEM THAT DEPLOYS IN THE EVENT OF A CRASH SHALL HAVE A MONITORING SYSTEM WITH A READINESS INDICATOR. A TOTALLY MECHANICAL SYSTEM IS EXEMPT FROM THIS REQUIREMENT.

Is the system totally mechanical? No

IF NO:

Describe the location of the readiness indicator:

The readiness indicator is a light stating "SRS" on the light panel above the center rear view mirror.

Is the readiness indicator clearly visible to the driver? Yes

Is a list of the elements in the occupant restraint system, being monitored by the readiness indicator, provided? Yes, Owner's
Manual, page 15

FIGURE 4 FMVSS 212 TEST DATA

DETAILS OF WINDSHIELD MOUNTING SUCH AS RETENTION METHOD, TRIM TYPE, ETC.:

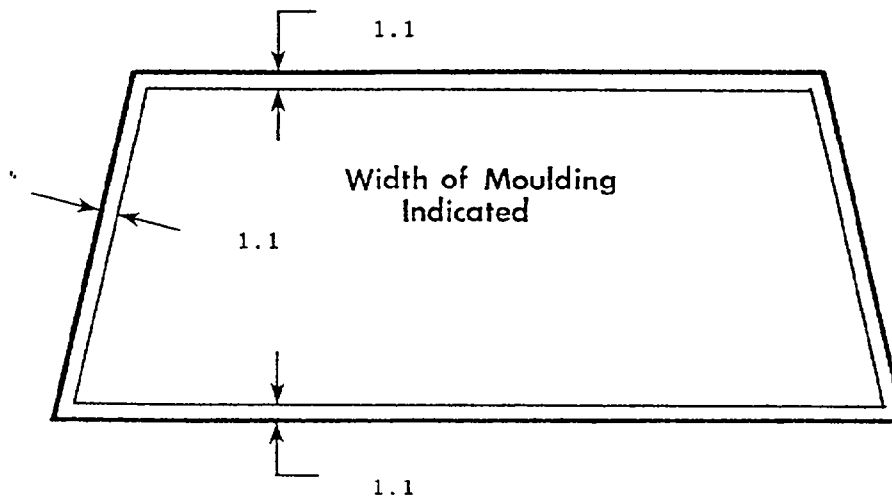
Adhesive around inner perimeter, plastic trim around outer perimeter.

FMVSS 212 REQUIREMENTS: The post-test periphery retention amount must be at least 75% of the pre-test periphery measurement for vehicles NOT equipped with automatic restraints, and 50% for each side of windshield for vehicles equipped with automatic restraint systems for front occupants.

WINDSHIELD PERIPHERY MEASUREMENTS:

	PRE-TEST	POST-TEST	PERCENT RETENTION
RIGHT SIDE	73.2	73.2	100%
LEFT SIDE	73.2	73.2	100%
TOTAL	146.4	146.4	100%

PRE-TEST WINDSHIELD MOUNTING MATERIAL TEMPERATURE: 70° F



FRONT VIEW OF WINDSHIELD*

LOSS OF WINDSHIELD RETENTION LENGTHS: None

ALL DISTANCE MEASUREMENTS ARE IN INCHES.

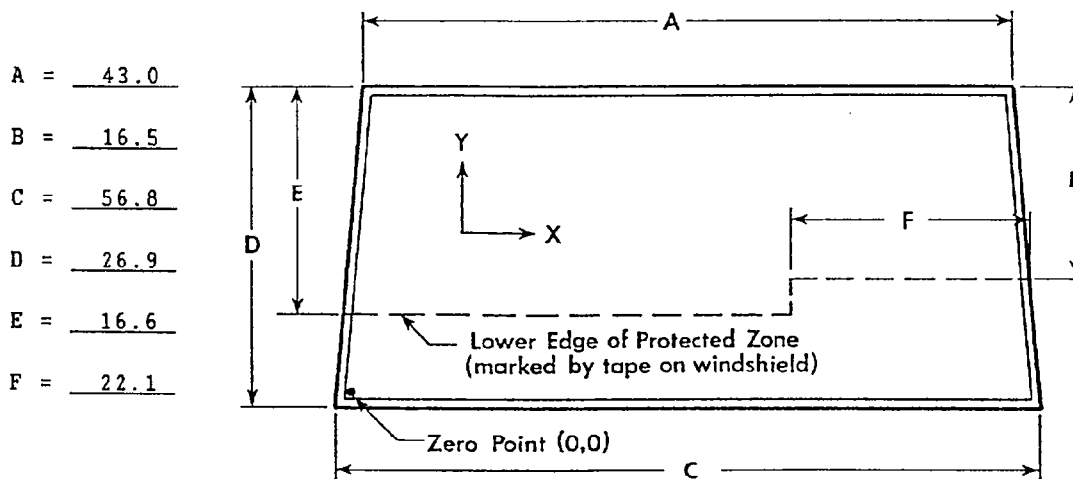
*INDICATE AREAS OF LOSS OF RETENTION, IF ANY, ON WINDSHIELD DIAGRAM.

FIGURE 5 FMVSS 219 TEST DATA

PROTECTED ZONE LOWER EDGE REQUIREMENT:

The lower edge of the protected zone is determined by placing a 6.5 inch diameter rigid sphere weighing 15 pounds in a position such that it simultaneously contacts the inner surface of the windshield and the top surface of the instrument panel including padding. Draw the locus of points on the inner surface of the windshield contactable by the sphere across the width of the instrument panel. From the outermost contactable points, extend the locus line horizontally to the edges of the windshield, and then draw a line on the inner surface of the windshield below and 0.5 inch from the locus line. The LOWER EDGE OF THE PROTECTED ZONE is the longitudinal projection onto the outer surface of the windshield of this line.

WINDSHIELD MEASUREMENTS:



FRONT VIEW

METHOD OF ADHERING PROTECTED ZONE TEMPLATE TO WINDSHIELD: NA

AREAS OF WINDSHIELD TEMPLATE PENETRATION
GREATER THAN 0.25 IN.: NA

COORDINATES	
<u> X Y </u>	
1.	
2.	
3.	

AREAS OF WINDSHIELD PENETRATION, BELOW THE PROTECTED ZONE,
THROUGH THE INNER SURFACE OF THE WINDSHIELD: None

1.
2.
3.

ALL MEASUREMENTS ARE IN INCHES.

TABLE 11 FUEL SYSTEM DATA

MAKE/MODEL: BMW 318is

NHTSA NO.: CM0503

FUEL SYSTEM CAPACITY: 16.4 GALLONS (FROM OWNER'S MANUAL)

USABLE CAPACITY: 14.5 GALLONS (FURNISHED BY COTR)

TEST VOLUME RANGE: 13.3 GALLONS TO 13.6 GALLONS (92-94% OF USABLE)

ACTUAL TEST VOLUME: 13.5 GALLONS (WITH ENTIRE FUEL SYSTEM FILLED)

TEST FLUID TYPE: STODDARD SOLVENT

SPECIFIC GRAVITY: 0.764

KINEMATIC VISCOSITY: 0.99 CENTISTOKES

TEST FLUID COLOR: PURPLE

DETAILS OF FUEL SYSTEM: The fuel tank is located in front of the rear
axle. The fuel filler neck was located on the right side. The fuel
lines run along the left frame rail to the front.

ELECTRIC FUEL PUMP: Yes

FUEL INJECTION: Yes

DOES ELECTRIC FUEL PUMP OPERATE WITH IGNITION SWITCH "ON" AND THE ENGINE NOT
OPERATING? No

TABLE 12 FMVSS 301 POST-IMPACT TEST DATA

TEST VEHICLE NHTSA NO.: CM0503; TEST DATE: 12/27/90
VEHICLE MAKE/MODEL/BODY STYLE: BMW 318is 2-door sedan

TEST REQUIREMENTS:

Test vehicle fuel tank filled to 92 to 94% of manufacturer's usable capacity and with electric fuel pump operating (if it will operate without engine operation). Part 572 test dummies located at each front designated seating position.

TEST VEHICLE IMPACT TYPE:

- ☒ FRONTAL (30 MPH)
☐ OBLIQUE (30 MPH) WITH ° BARRIER FACE
FIRST CONTACTING (DRIVER/PASS.) SIDE.
☐ REAR MOVING BARRIER (30 MPH)
☐ LATERAL MOVING BARRIER (20 MPH)

FUEL SYSTEM FLUID SPILLAGE MEASUREMENTS:

	<u>TEST RESULTS</u>	<u>MAXIMUM ALLOWABLE</u>
1. FROM IMPACT UNTIL VEHICLE MOTION CEASES - - -	0 OZ.	1 OZ.
2. 5 MINUTE PERIOD AFTER VEHICLE MOTION CEASES -	0 OZ.	5 OZ.
3. NEXT 25 MINUTES AFTER 5 MINUTE PERIOD - - -	0 OZ.	1 OZ./1 MIN.

FUEL SYSTEM FLUID SPILLAGE LOCATION(S):

None

SECTION 4.0

VEHICLE, OCCUPANT, AND CAMERA MEASUREMENTS

FIGURE 6

PRE-TEST AND POST-TEST MEASUREMENT POINTS

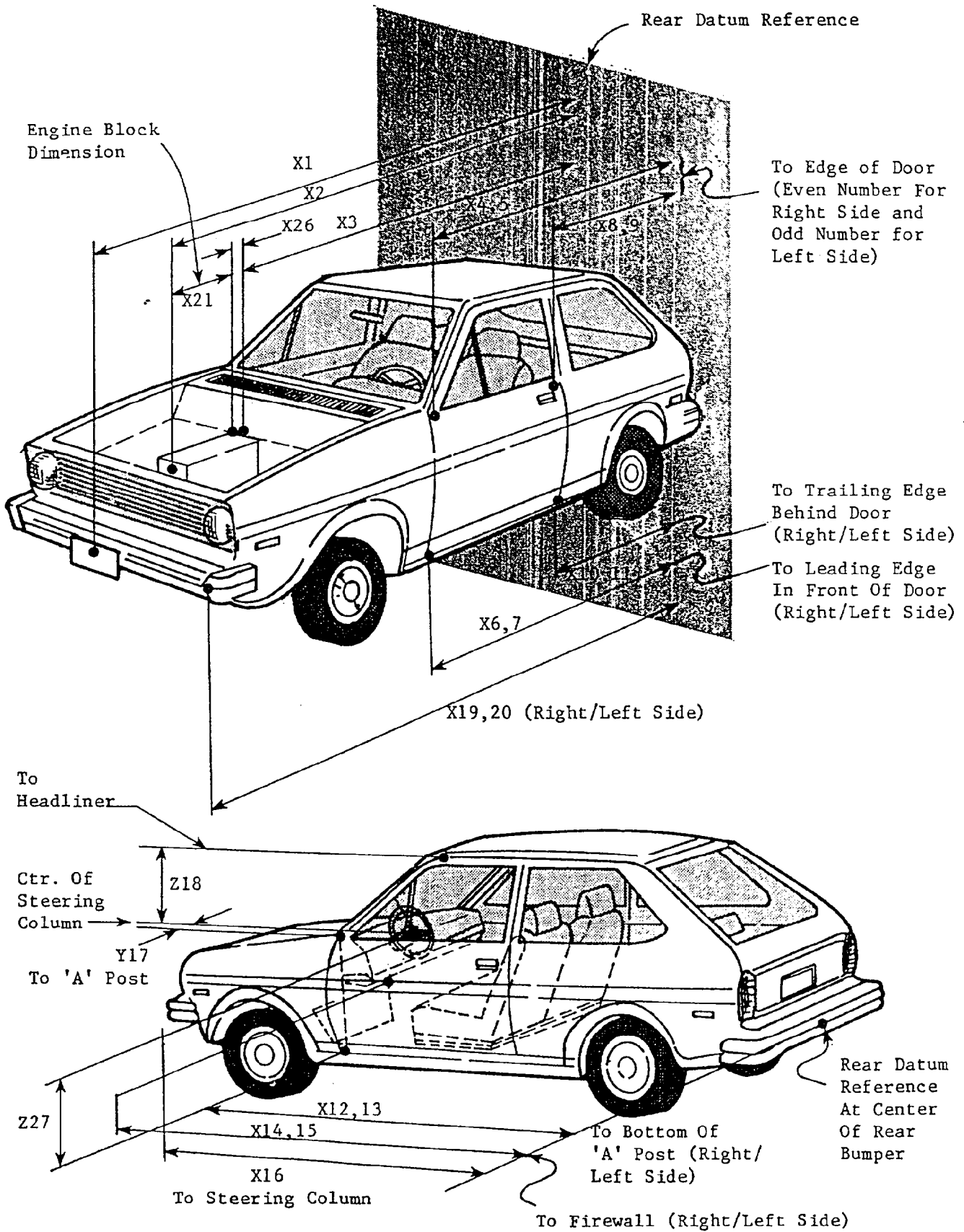
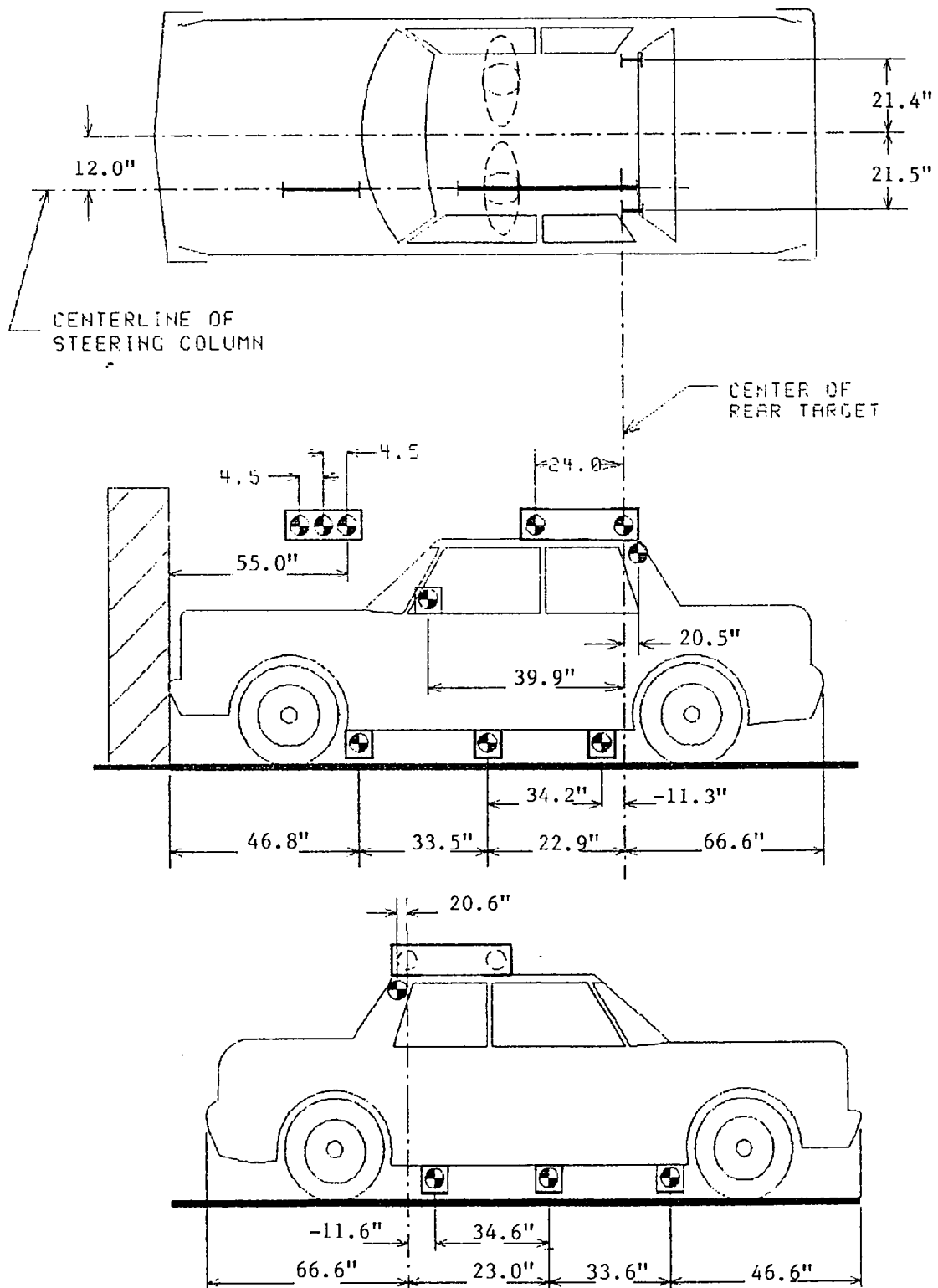


TABLE 13 IMPACTED VEHICLE MEASUREMENTS

VEHICLE MAKE/MODEL: BMW 318is		TEST NUMBER: 901227	ALL MEASUREMENTS ARE IN INCHES		
NO.	TYPE OF MEASUREMENT		PRE-TEST	POST-TEST	DIFF.
X1	TOTAL LENGTH OF VEHICLE AT CENTERLINE		169.8	152.8	17.0
X2	REAR SURFACE OF VEHICLE TO FRONT OF ENGINE BLOCK		149.0	140.6	8.4
X3	REAR SURFACE OF VEHICLE TO FIREWALL		127.5	124.2	3.3
X4	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF RIGHT DOOR		116.2	115.9	0.3
X5	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF LEFT DOOR		116.0	116.0	0.0
X6	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF RIGHT DOOR		117.1	116.8	0.3
X7	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF LEFT DOOR		116.8	116.5	0.3
X8	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF RIGHT DOOR		70.9	70.6	0.3
X9	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF LEFT DOOR		70.9	71.0	-0.1
X10	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF RIGHT DOOR		71.9	71.5	0.4
X11	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF LEFT DOOR		72.0	71.5	0.5
X12	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON RIGHT SIDE		116.5	115.9	0.6
X13	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON LEFT SIDE		116.4	115.9	0.5
X14	REAR SURFACE OF VEHICLE TO FIREWALL - RIGHT SIDE		123.2	122.5	0.7
X15	REAR SURFACE OF VEHICLE TO FIREWALL - LEFT SIDE		125.0	123.8	1.2
X16	REAR SURFACE OF VEHICLE TO STEERING WHEEL CENTER		101.2	99.9	1.3
X17	CENTER OF STEERING COLUMN TO "A" POST		13.5	13.6	-0.1
X18	CENTER OF STEERING COLUMN TO HEADLINER		17.6	14.8	2.8
X19	REAR SURFACE OF VEHICLE TO RIGHT SIDE OF FRONT BUMPER		165.8	150.5	15.3
X20	REAR SURFACE OF VEHICLE TO LEFT SIDE OF FRONT BUMPER		165.5	150.2	15.3
X21	LENGTH OF ENGINE BLOCK		19.0	19.0	0.0

FIGURE 7
VEHICLE TARGET LOCATIONS



ALL DISTANCE MEASUREMENTS ARE IN INCHES.

FIGURE 8 DUMMY AND SEAT POSITIONING DATA

PRE-IMPACT DATA:

MAKE/MODEL: BMW 318is
 BODY STYLE: 2-door sedan MODEL YEAR: 1991
 NHTSA NO.: CM0503 COLOR: Silver

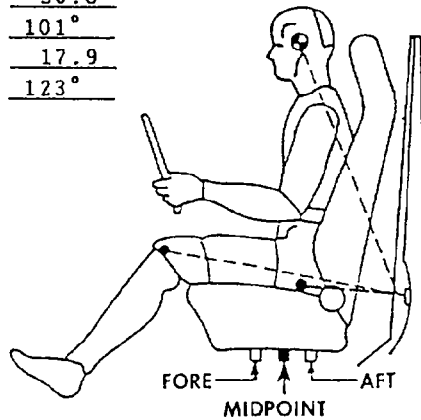
DATA FROM CERTIFICATION LABEL:

VEHICLE MANUFACTURER: Bayerische Motoren Werke Ag.
 DATE OF MANUFACTURE: 10/90 VIN: WBAAF9312MEE71524
 GVWR: 3571 LBS.; GAWR: FRONT = 1698 LBS.; REAR = 1940 LBS.

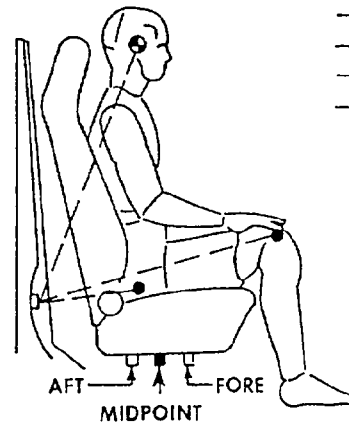
POST-IMPACT DATA:

DATE OF TEST: 12/27/90 TIME: 1149 TEMPERATURE: 70° F
 IMPACT VELOCITY: PRIMARY = 29.5 MPH SECONDARY = 29.5 MPH
 REQUIRED IMPACT VELOCITY RANGE: 28.9 TO 29.9 MPH
 SEAT TYPE: Bucket ADJUSTER TYPE: Manual
 FRONT SEAT BACK TYPE: Manual Adjustable
 TECHNICIANS: R. Branham, P. Cummins, R. Benavides

DRIVER DUMMY #1173 TYPE: HII
 HEAD 17.2
 TARGET 22°
 KNEE 30.8
 JOINT 101°
 APPROX- 17.9
 IMATE 123°
 "H"
 POINT



PASSENGER DUMMY # 353 TYPE: HII
 HEAD 18.8
 TARGET 25°
 KNEE 31.4
 JOINT 102°
 APPROX- 17.6
 IMATE 121°
 "H"
 POINT



A = 45.5
 B = 34.7
 C = 22.8
 D = 10.8
 E = 10.8

DOOR GLASS
 HEIGHT = 9.5

LATERAL BAR
 ADJUSTABLE
 POINTER

LEFT
 FRONT
 DOOR

DRIVER
 DUMMY

PASSENGER
 DUMMY

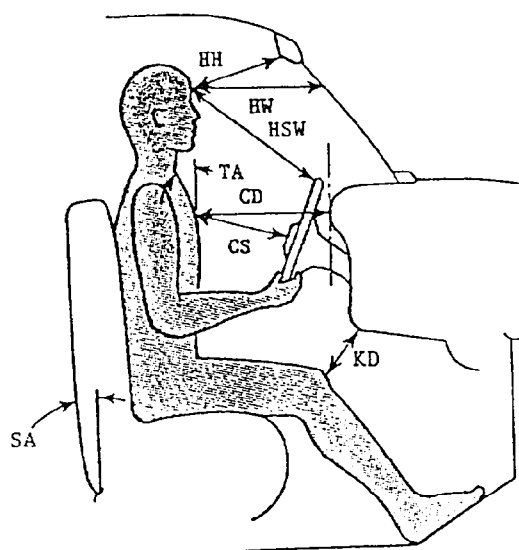
DOOR GLASS
 HEIGHT = 9.5

RIGHT
 FRONT
 DOOR

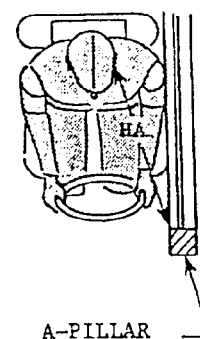
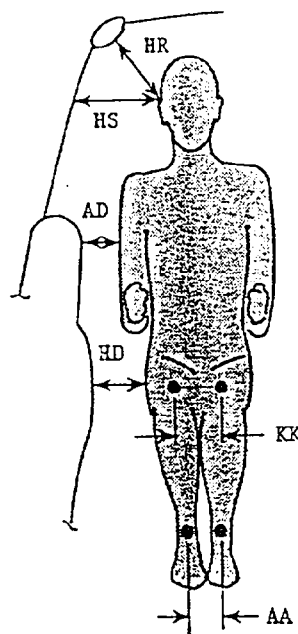
ALL ANGLES ARE RELATIVE TO VERTICAL PLANE THROUGH DOOR STRIKER.
 ALL DISTANCE MEASUREMENTS ARE IN INCHES.

FIGURE 9 DUMMY IN VEHICLE POSITIONING DATA

	DRIVER	PASSENGER
HH	17.5	15.1
HW	23.9	21.1
CD	22.9	22.7
CS	14.4	NA
KDL	6.9	7.6
KDR	5.8	8.5
TA	26°	20°
SA	20.5°	20.5°
HSW	21.0	NA



	DRIVER	PASSENGER
HR	6.4	5.6
HS	7.9	7.6
AD	3.1	2.9
HD	4.9	5.4
KK	10.2	7.5
AA	11.0	8.0
HA	21.6	15.1



KNEE OUTER BOLT TO OUTER
BOLT HEAD SPACING:

DRIVER = 14.5

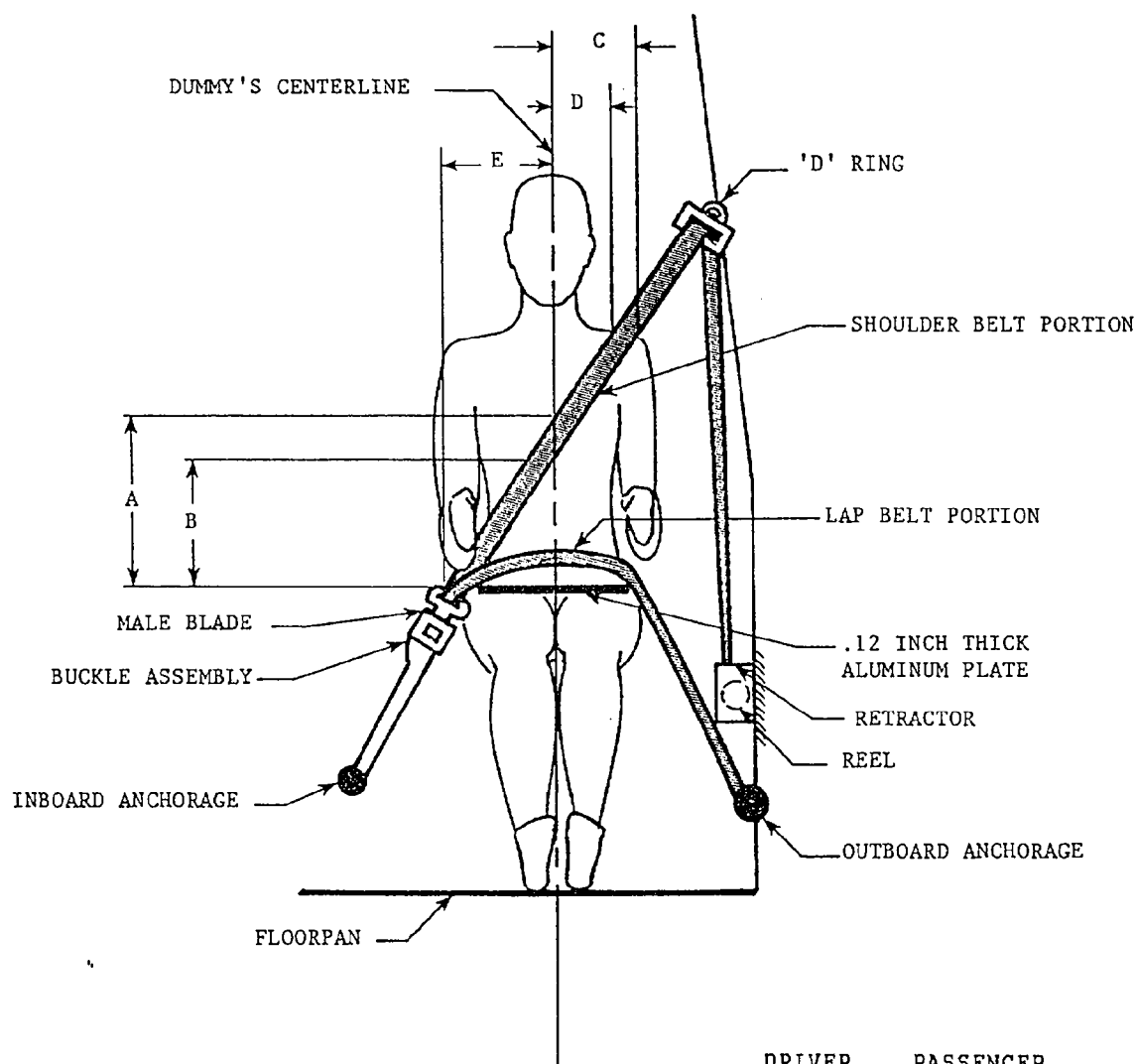
PASSENGER = 11.8

HH = HEAD TO WINDSHIELD HEADER
HW = HEAD TO WINDSHIELD
CD = CHEST TO DASH
CS = CHEST TO STEERING WHEEL
KD = KNEE TO DASH
TA = TORSO ANGLE
SA = SEAT BACK ANGLE
HSW = HEAD TO STEERING WHEEL

HR = HEAD C.G. TARGET TO SIDE ROOF HEADER
HS = HEAD C.G. TARGET TO SIDE WINDOW
AD = ARM TO DOOR
HD = HIP TO DOOR
KK = KNEE TO KNEE
AA = ANKLE TO ANKLE
HA = HEAD C.G. TARGET TO A-PILLAR

TORSO AND SEAT BACK ANGLES ARE RELATIVE TO VERTICAL.
ALL DISTANCE MEASUREMENTS ARE IN INCHES.

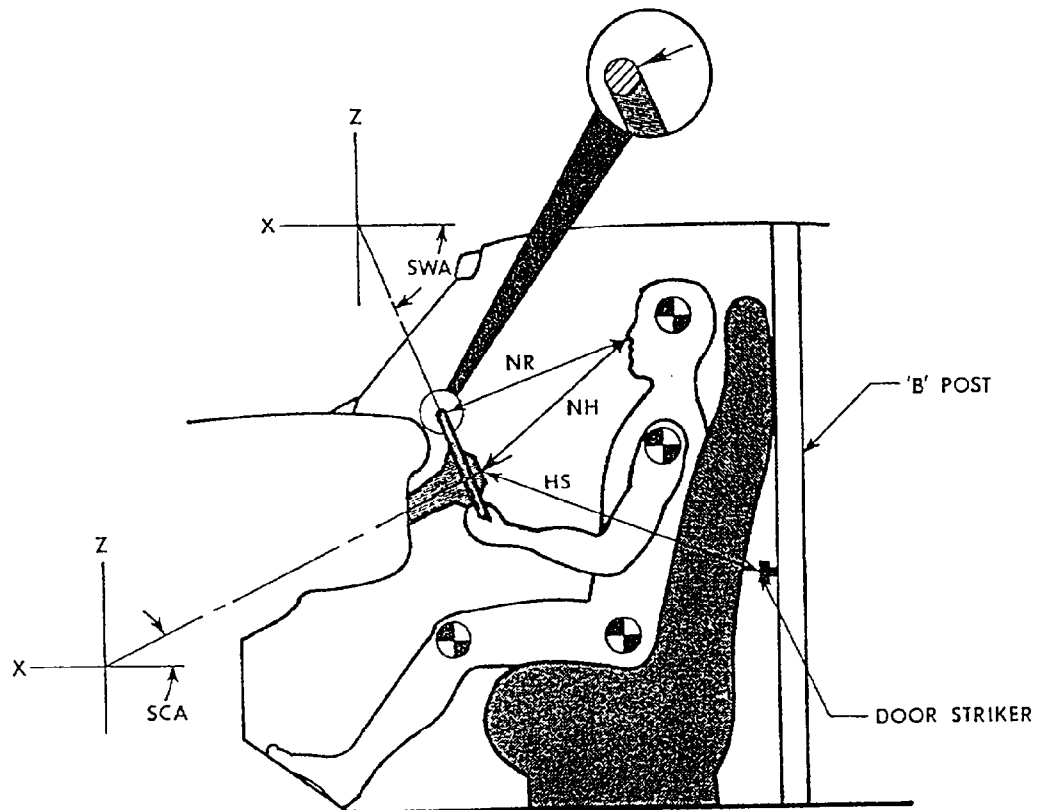
FIGURE 10 SEAT BELT POSITIONING DATA



	DRIVER DUMMY	PASSENGER DUMMY
A - TOP SURFACE OF ALUMINUM PLATE TO BELT UPPER EDGE	NA	14.5
B - TOP SURFACE OF ALUMINUM PLATE TO BELT LOWER EDGE	NA	11.5
C - DUMMY CENTERLINE TO OUTER EDGE OF BELT AT CHEST FLESH TOP	NA	1.5
D - DUMMY CENTERLINE TO INNER EDGE OF BELT AT CHEST FLESH TOP	NA	3.8
E - DUMMY CENTERLINE TO INTERSECTION OF UPPER TORSO BELT AND LAP BELT	NA	8.5

ALL MEASUREMENTS ARE IN INCHES.

FIGURE 11 DRIVER DUMMY TO STEERING COLUMN/WHEEL ASSEMBLY DATA



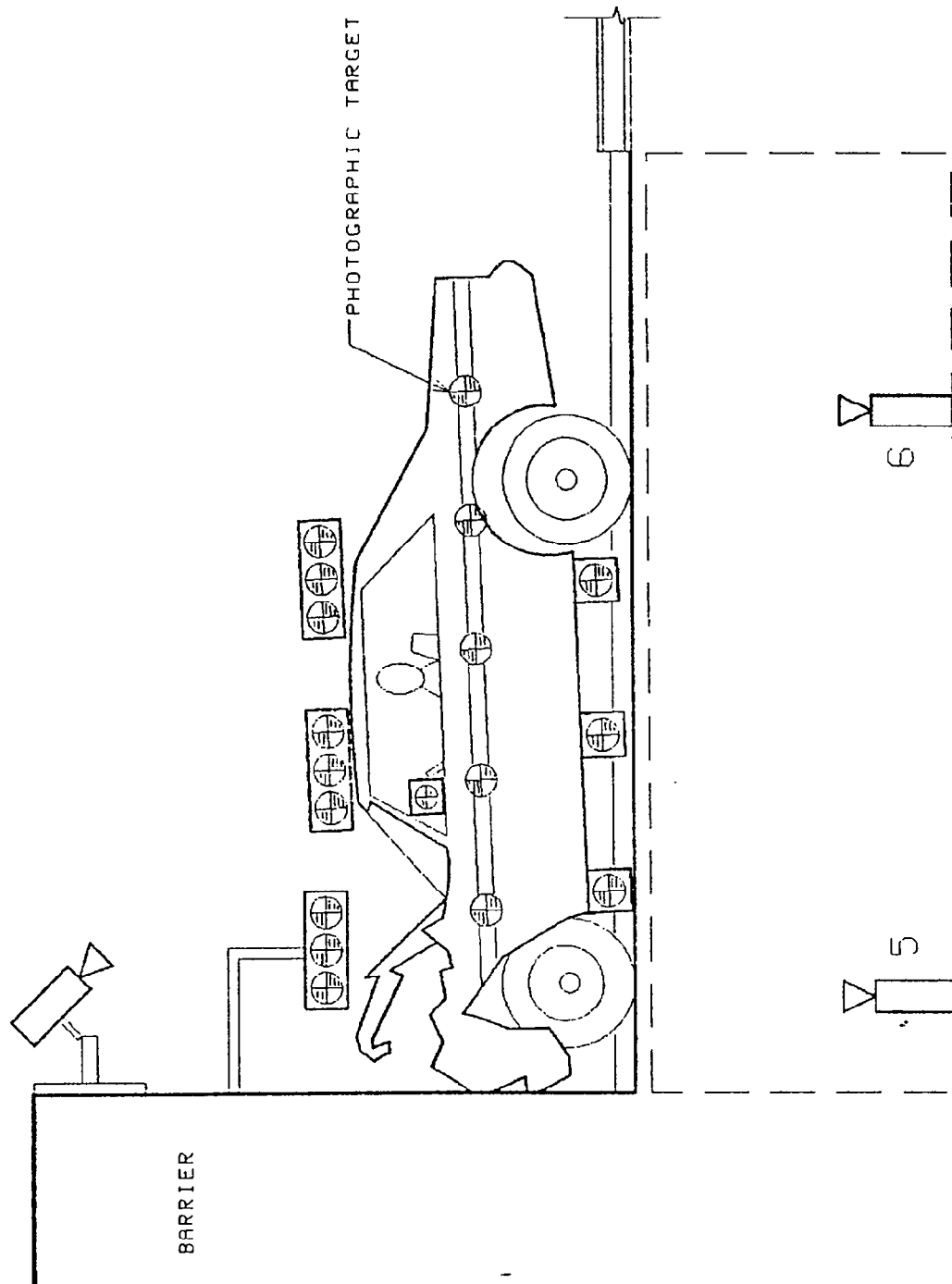
POSITION OF STEERING COLUMN TILTING AND TELESCOPING ADJUSTMENTS, IF ANY:
The steering column was not adjustable.

MEASUREMENTS

NR	- DISTANCE FROM TIP OF DUMMY'S NOSE TO TOP REAR SURFACE OF STEERING WHEEL RIM.	19.2
NH	- DISTANCE FROM TIP OF DUMMY'S NOSE TO CENTER OF STEERING COLUMN HUB.	18.8
HS	- DISTANCE FROM CENTER OF STEERING COLUMN HUB TO THE FORWARD SURFACE OF THE DOOR LOCK STRIKER PIN.	29.4
SCA	- ANGLE OF STEERING COLUMN RELATIVE TO THE HORIZONTAL X AXIS	30°
SWA	- ANGLE OF STEERING WHEEL RELATIVE TO THE HORIZONTAL X AXIS	60°

ALL DISTANCE MEASUREMENTS ARE IN INCHES.

4, 7, 8 CAMERA POSITIONS FIGURE 12



CAMERA POSITIONS, CONTINUED FIGURE 12

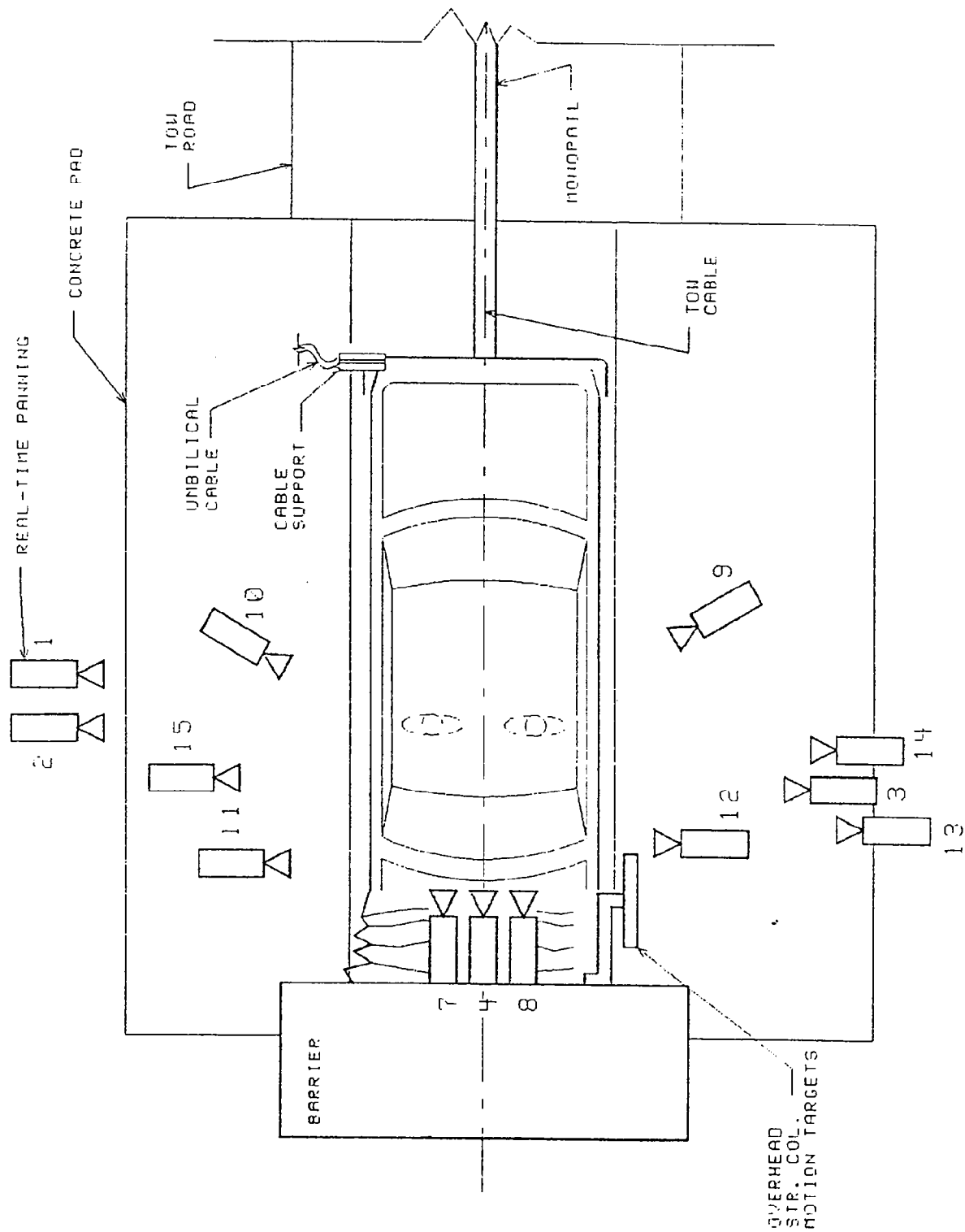


TABLE 14 MOTION PICTURE CAMERA LOCATIONS

TEST NO.: 901227		VEHICLE: BMW 318is																	
CAMERA NO.	VIEW	X	Y	Z	ANGLE** (DEG)	FILM PLANE TO HEAD TARGET (IN)	LENS (MM)	FILM SPEED (FPS)											
1	Real-time panning	-142.0	-504.0	61.0	NA	NA	16	24											
2	Vehicle crush	-81.3	-266.4	37.1	-2	NA	13	488											
3	Dummy kinematics	-41.5	295.0	44.0	-4	228.0	25	500											
4	Windshield damage	-6.0	0.0	98.0	-40	NA	8.5	498											
5	Crush & fluid spillage	-50.5	0.0	-92.4	90	NA	13	1002											
6	Fluid spillage	-99.3	0.0	-99.0	90	NA	13	1000											
7	Passenger kinematics	-4.5	-13.8	93.0	-50	NA	17	495											
8	Driver kinematics	-6.8	14.5	93.0	-50	NA	17	500											
9	Driver kinematics	-157.3	116.0	87.0	-27	97.0	25	500											
10	Passenger kinematics	-152.1	-116.0	87.0	-26	91.0	25	500											
11	Windshield intrusion	-38.1	-306.1	44.0	0	NA	50	498											
12	Windshield intrusion	-53.0	309.4	42.3	0	NA	50	500											
13	Column movement	-143.0	276.0	103.0	-14	NA	25	500											
14	Column movement	-143.0	276.0	75.1	-9	NA	25	500											
15	Passenger kinematics	-38.8	-293.0	45.3	-4	240.0	25	502											
16	Real-time documentation	NA	NA	NA	NA	NA	12-120	24											

* +X = Film plane forward of barrier face

+Y = Film plane to left of monorail centerline

+Z = Film plane above ground level

** +Angle = Film plane angled upward from horizontal plane

APPENDIX A

PHOTOGRAPHS



Figure A-1. PRE-TEST FRONT VIEW

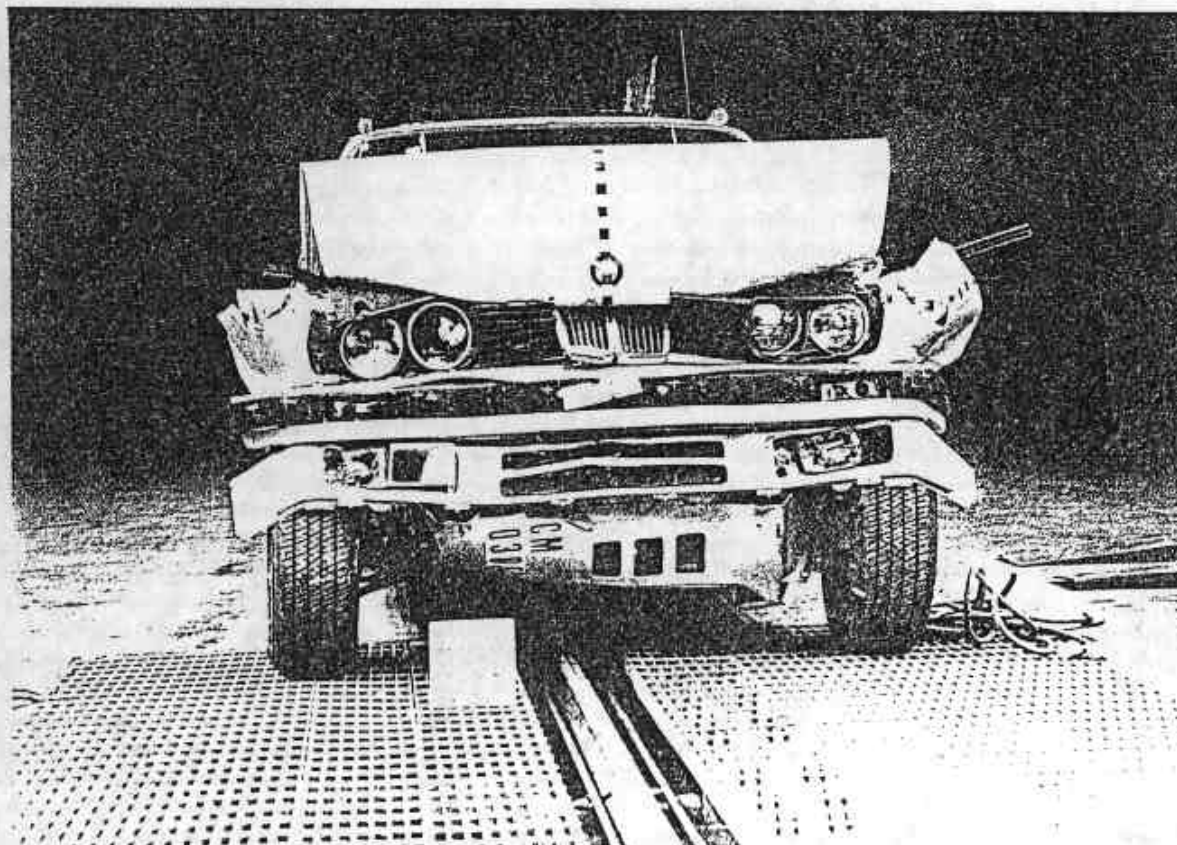


Figure A-2. POST TEST FRONT VIEW

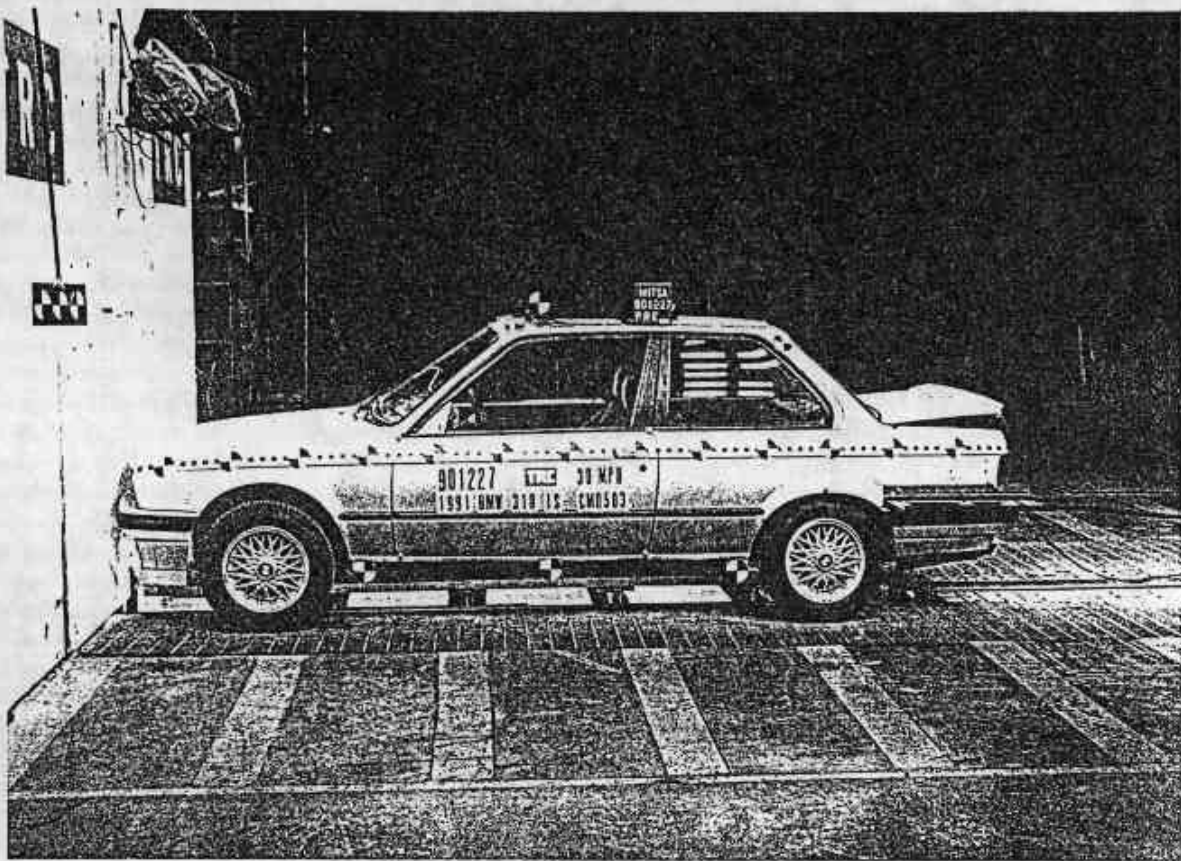


Figure A-3. PRE-TEST LEFT SIDE VIEW

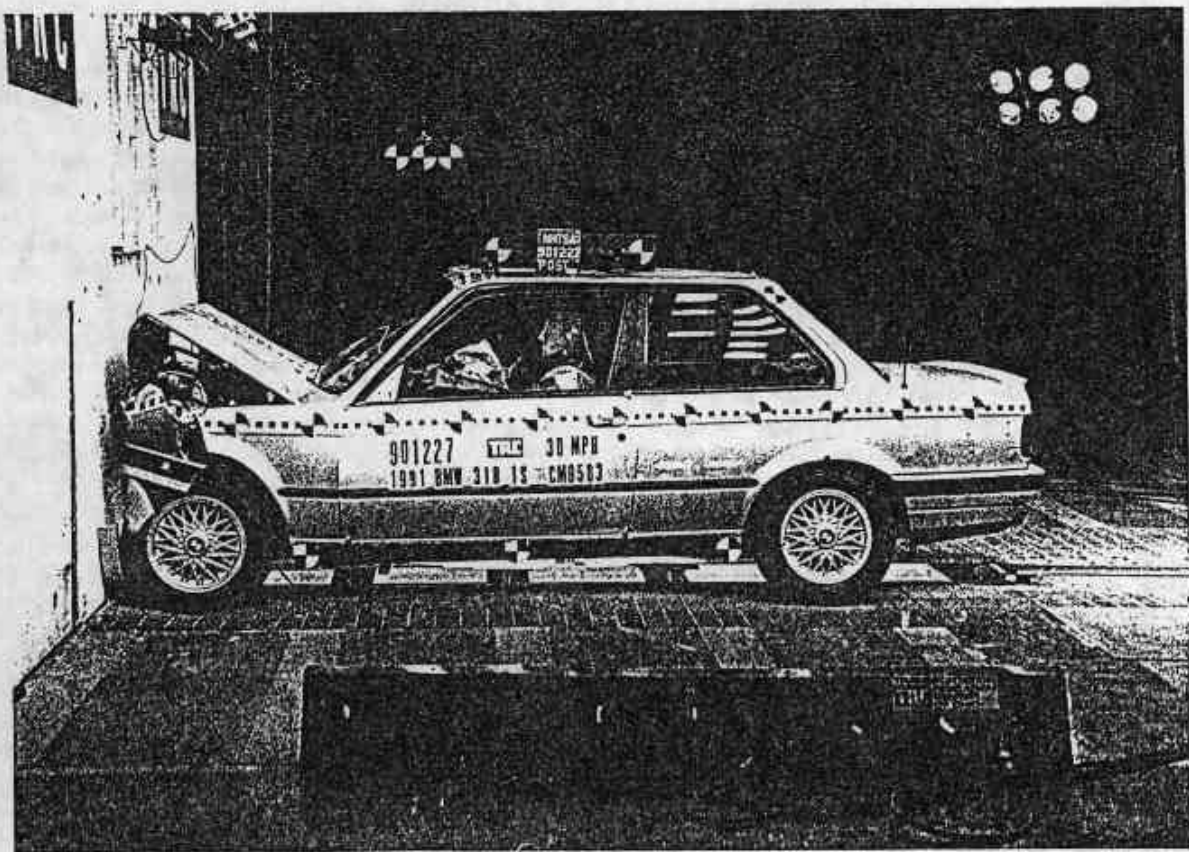


Figure A-4. POST-TEST LEFT SIDE VIEW

A-3

901227

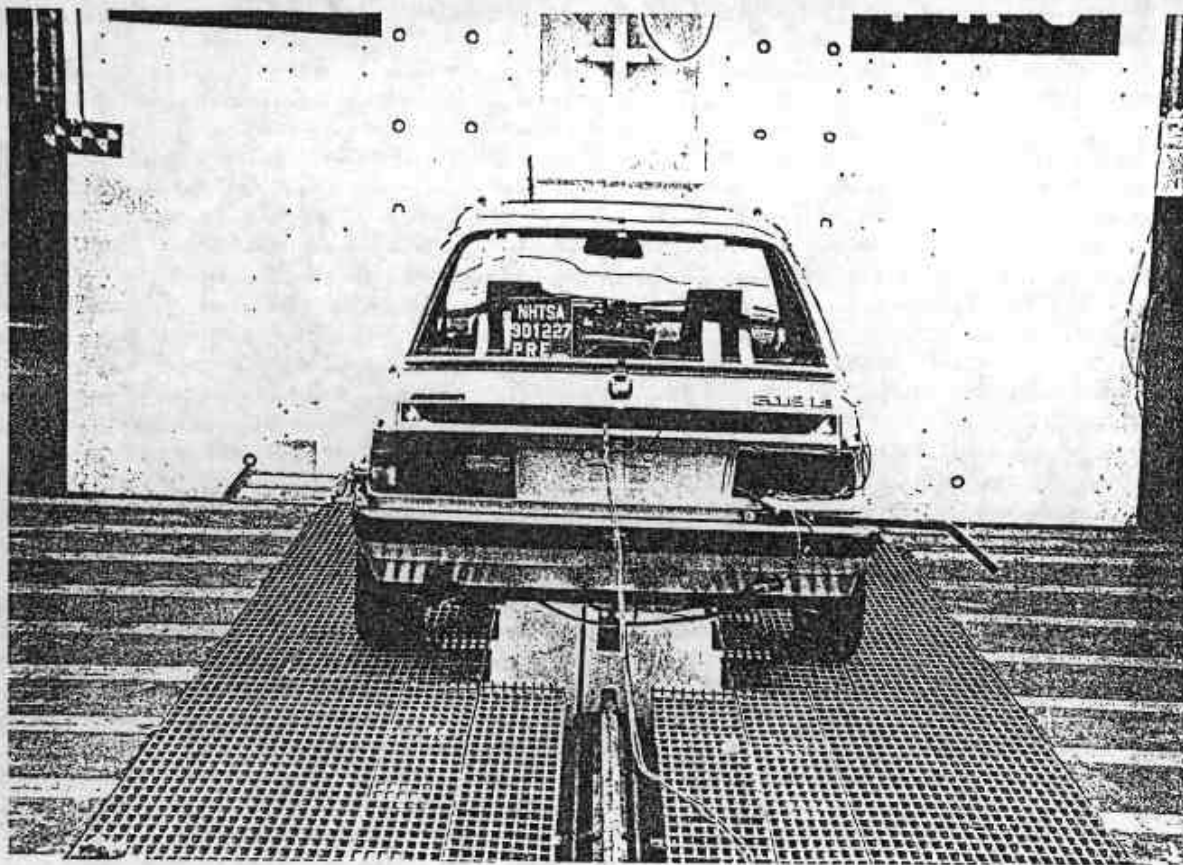


Figure A-5. PRE-TEST REAR VIEW



Figure A-6. POST-TEST REAR VIEW

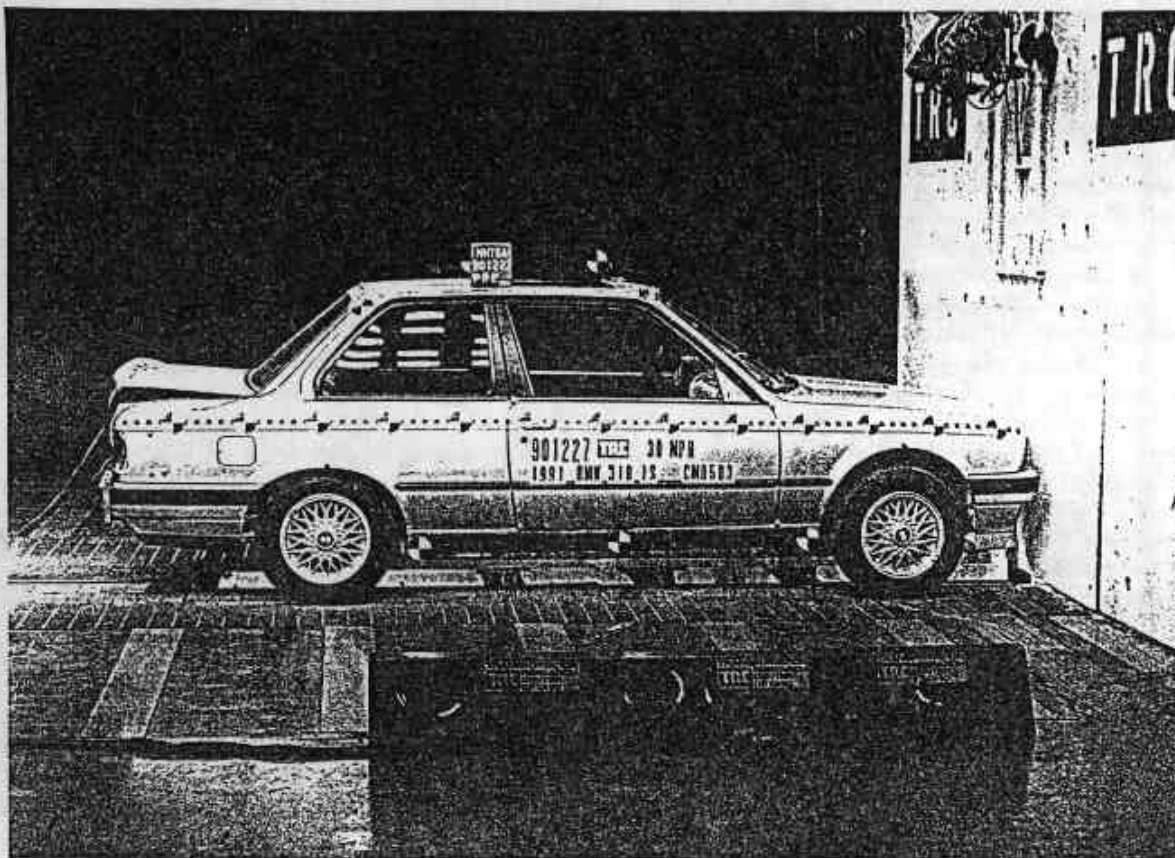


Figure A-7. PRE-TEST RIGHT SIDE VIEW



Figure A-8. POST-TEST RIGHT SIDE VIEW

A-5

901227



Figure A-9. PRE-TEST RIGHT FRONT THREE-QUARTER VIEW



Figure A-10. POST-TEST RIGHT REAR THREE-QUARTER VIEW



Figure A-11. PRE-TEST LEFT REAR THREE-QUARTER VIEW



Figure A-12. POST-TEST LEFT REAR THREE-QUARTER VIEW

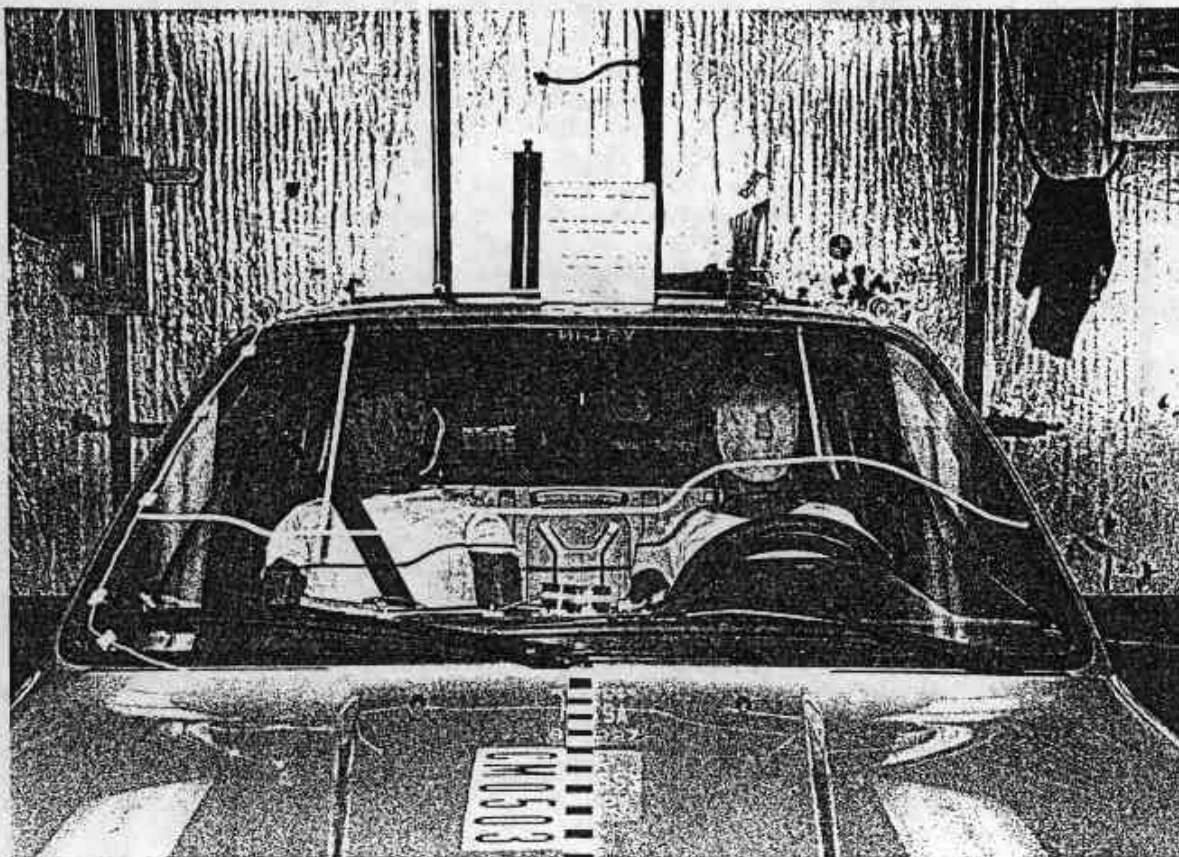


Figure A-13. PRE-TEST WINDSHIELD VIEW

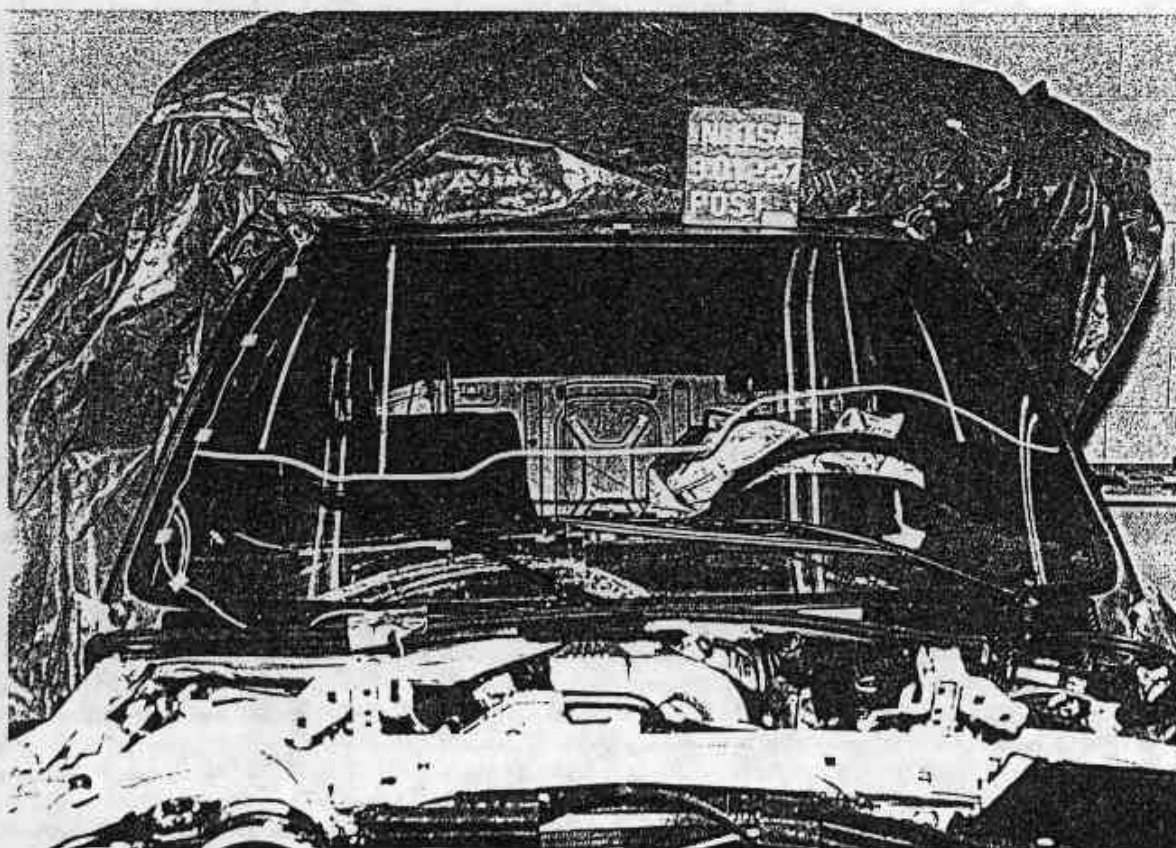


Figure A-14. POST-TEST WINDSHIELD VIEW



Figure A-15. PRE-TEST ENGINE COMPARTMENT VIEW



Figure A-16. POST-TEST ENGINE COMPARTMENT VIEW

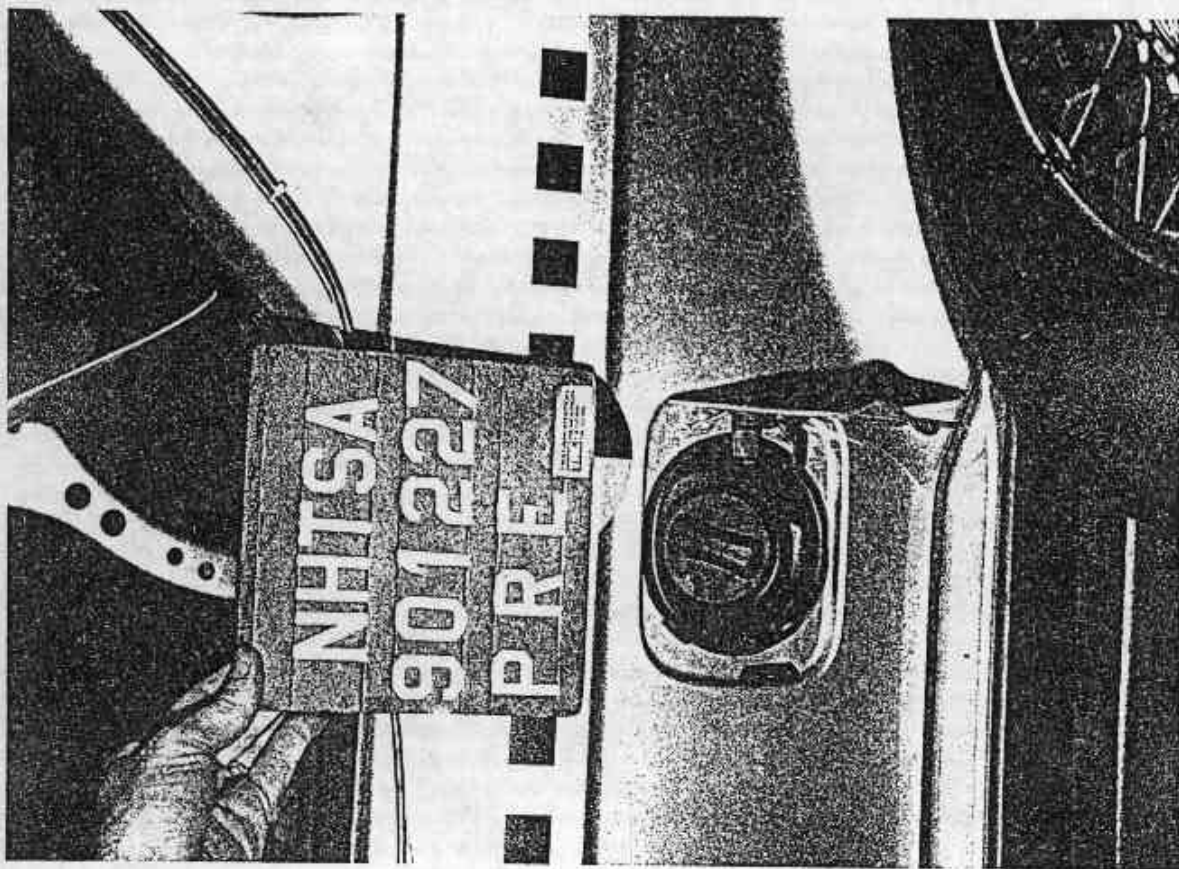


Figure A-17. PRE-TEST FUEL FILLER CAP VIEW

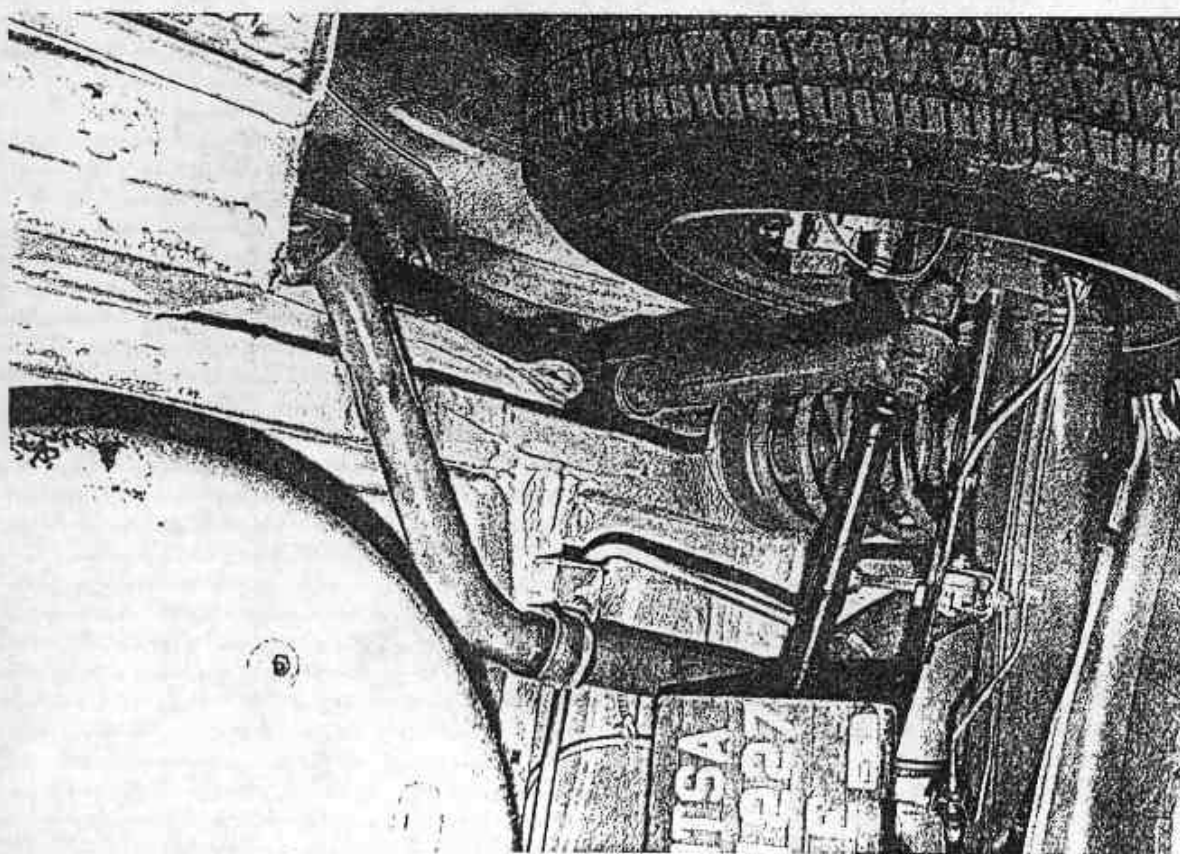


Figure A-18. PRE-TEST FUEL FILLER NECK VIEW

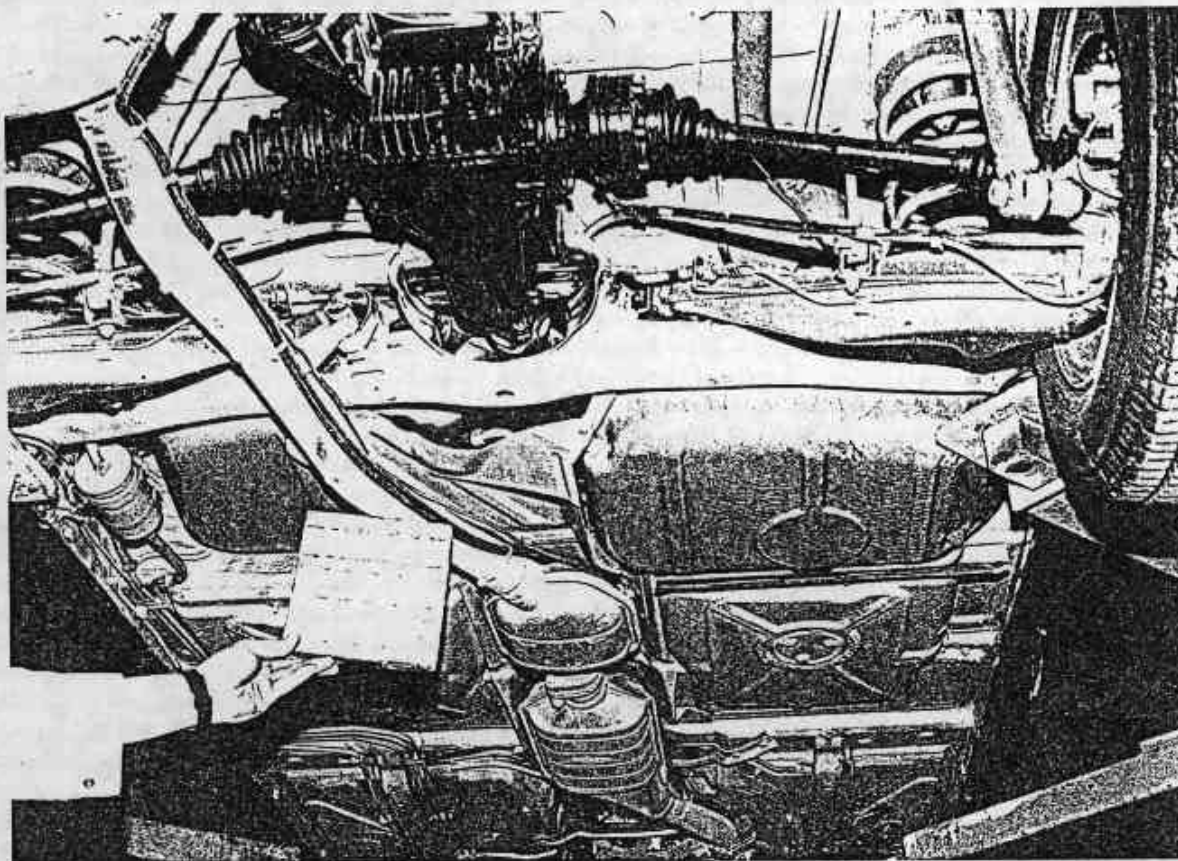


Figure A-19. PRE-TEST FUEL TANK VIEW

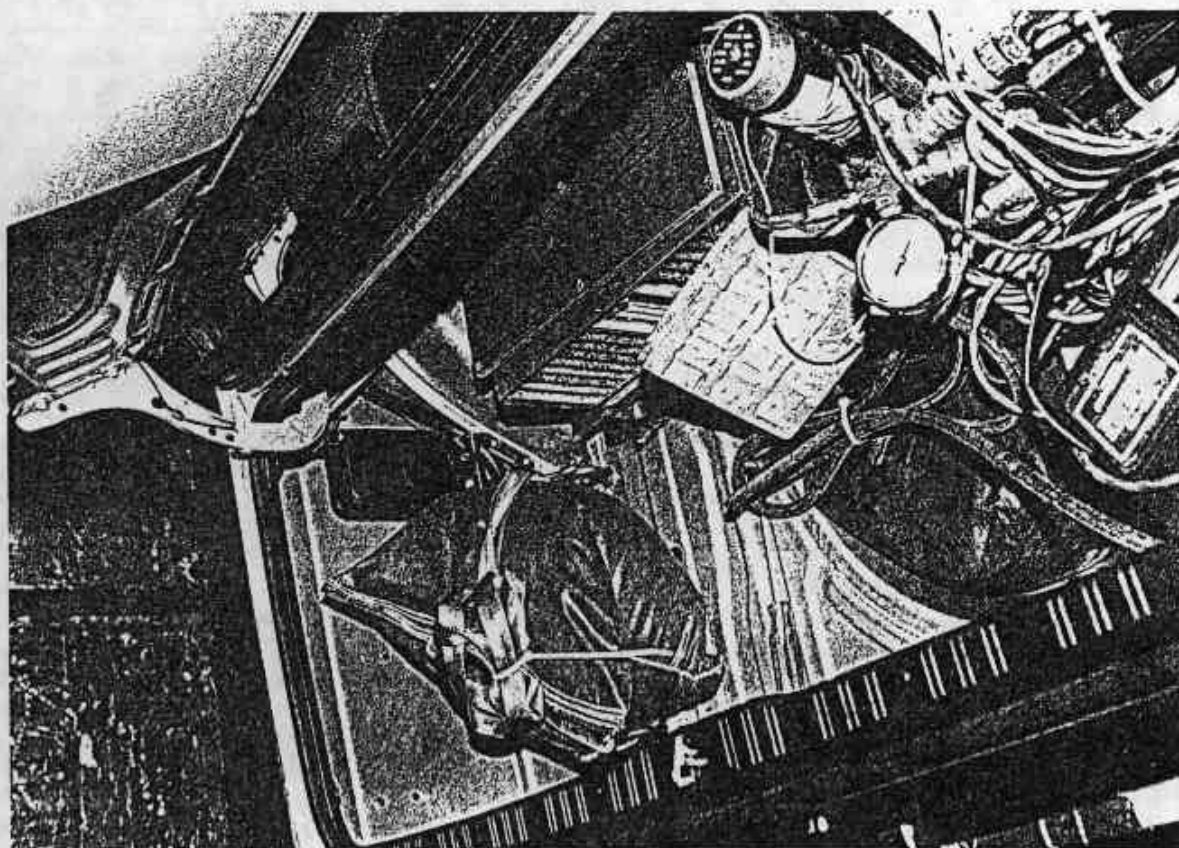


Figure A-20. PRE-TEST BALLAST LOCATION VIEW
A-11

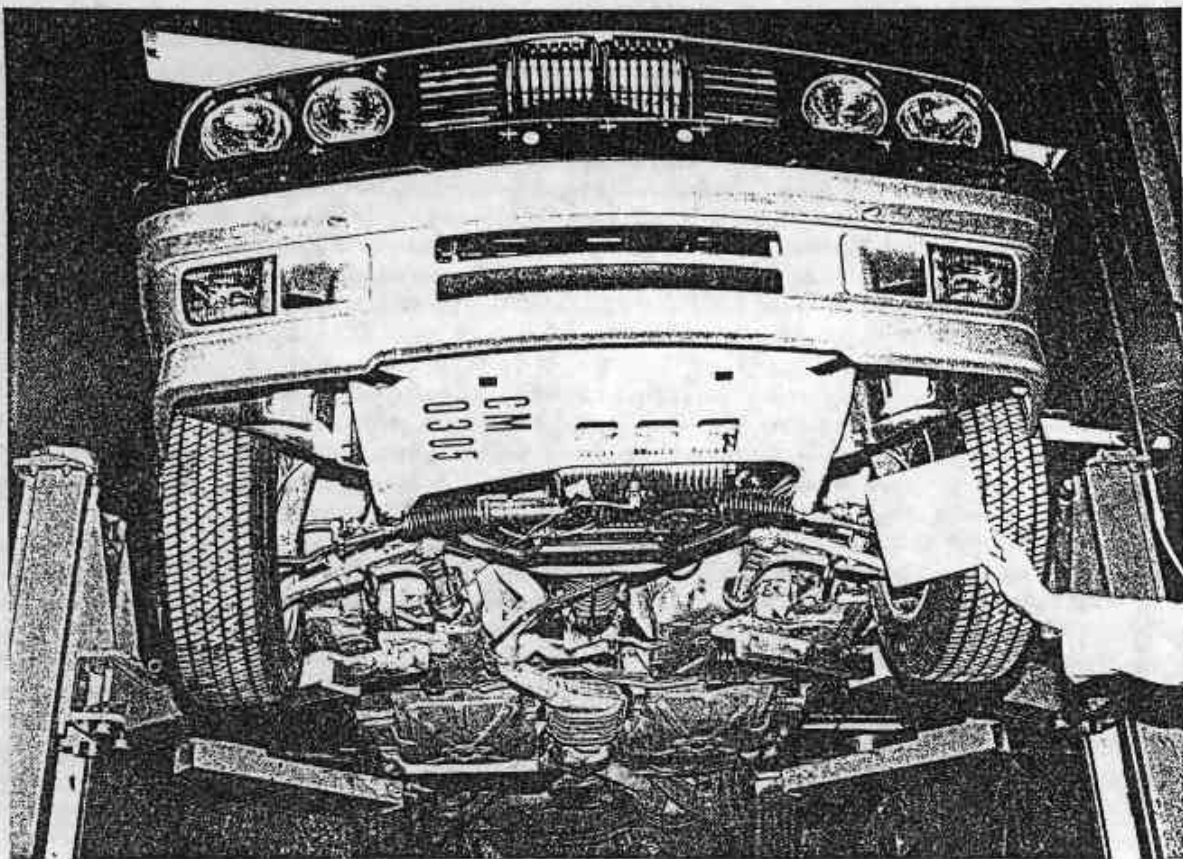


Figure A-21. PRE-TEST FRONT UNDERBODY VIEW

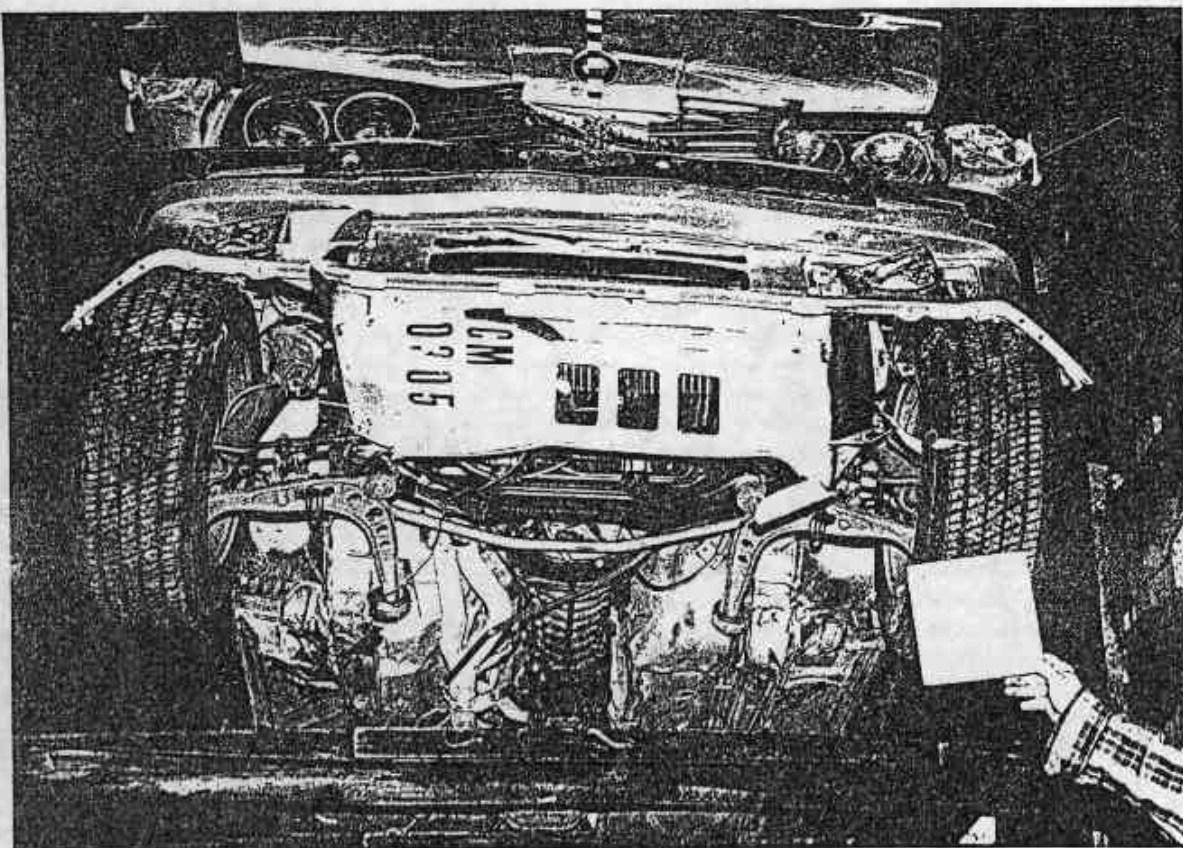


Figure A-22. POST-TEST FRONT UNDERBODY VIEW

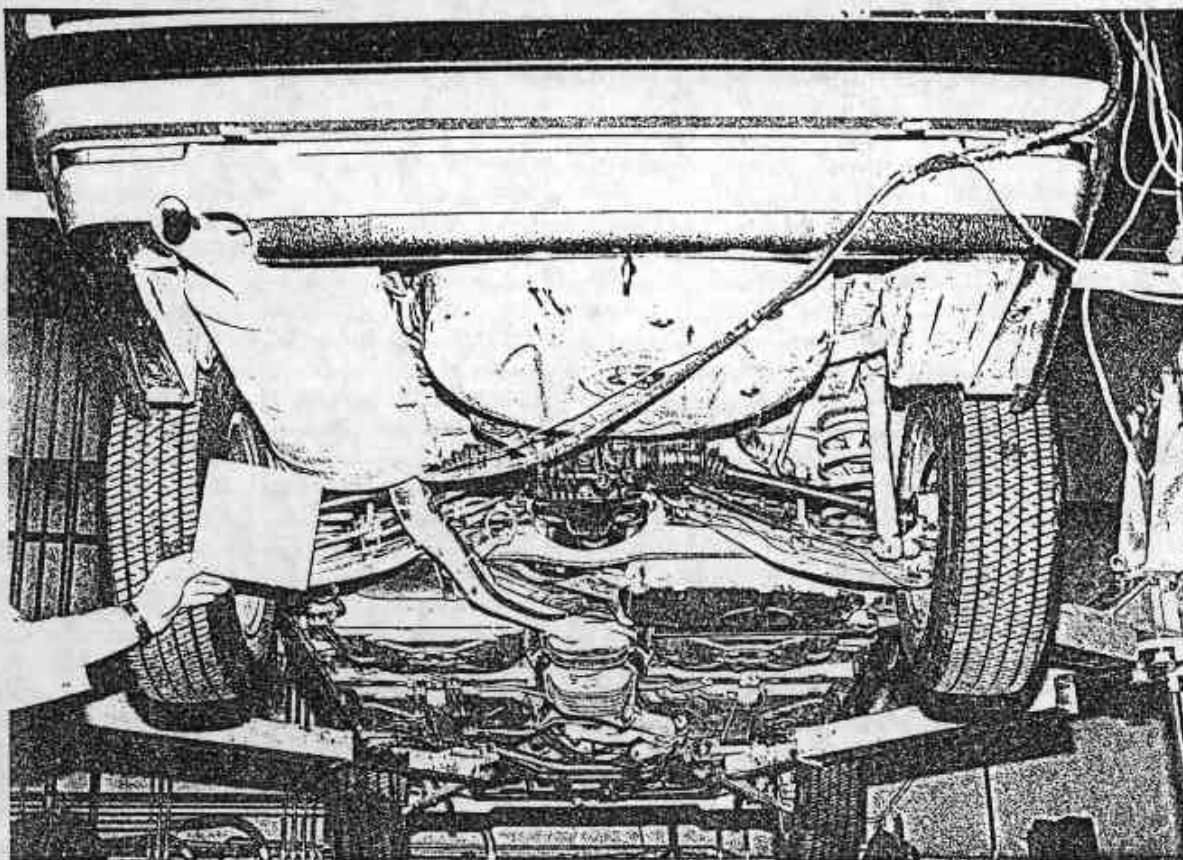


Figure A-23. PRE-TEST REAR UNDERBODY VIEW

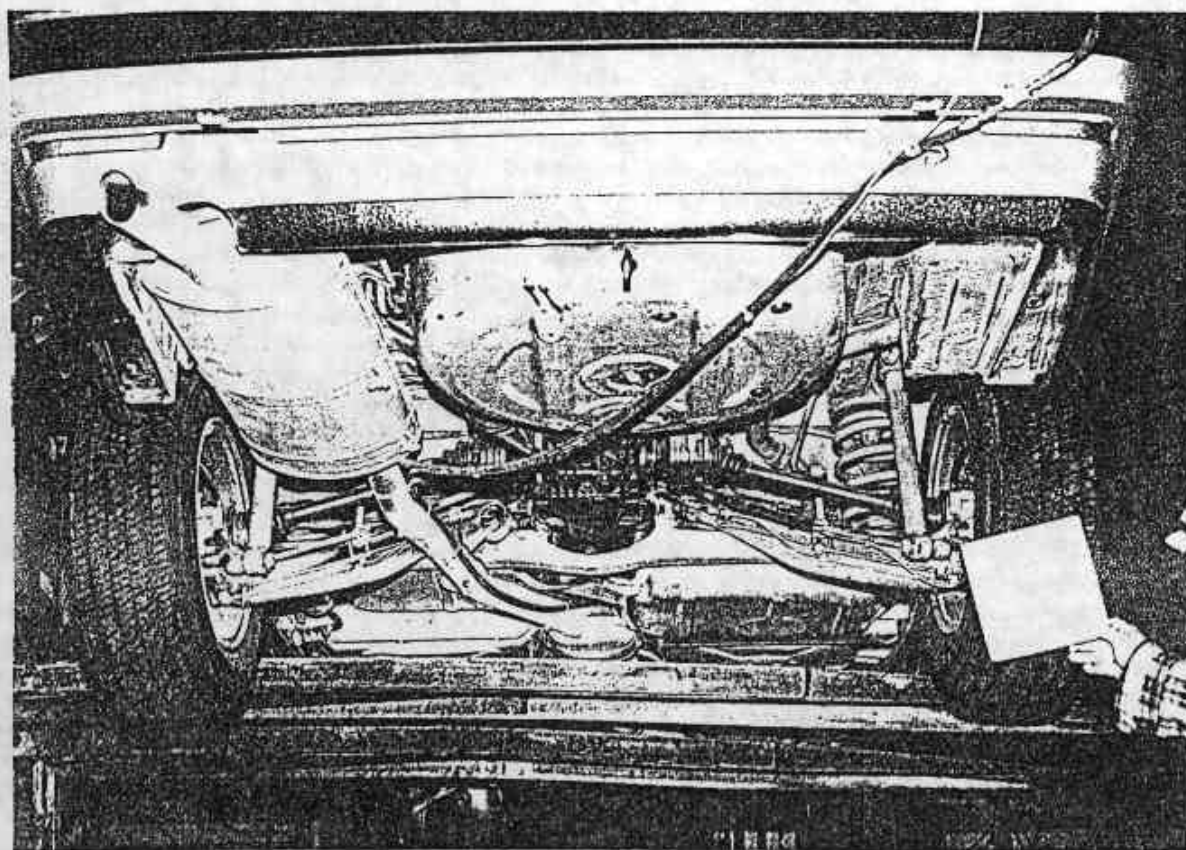


Figure A-24. POST-TEST REAR UNDERBODY VIEW
A-13

901227



Figure A-25. PRE-TEST DRIVER DUMMY POSITION VIEW



Figure A-26. POST-TEST DRIVER DUMMY POSITION VIEW

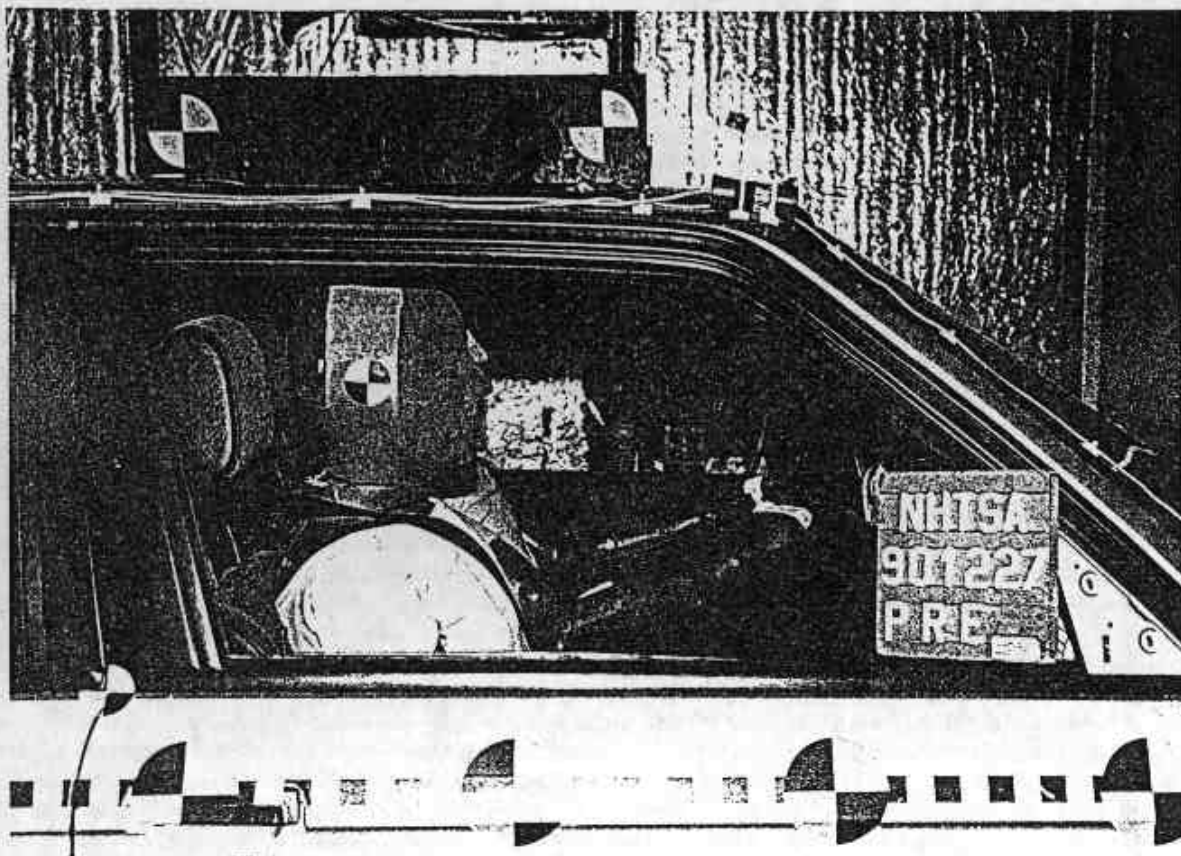


Figure A-27. PRE-TEST PASSENGER DUMMY POSITION VIEW



Figure A-28. POST-TEST PASSENGER DUMMY POSITION VIEW

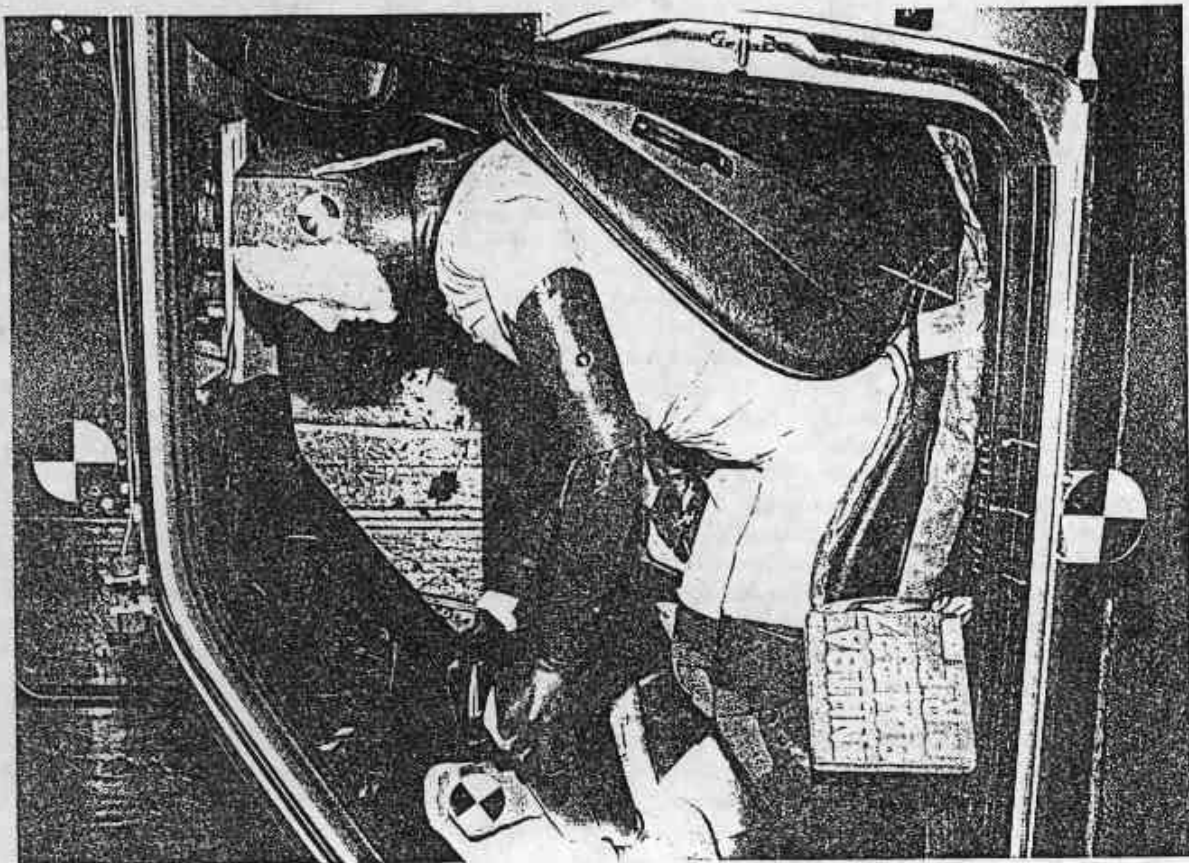


Figure A-29. PRE-TEST DRIVER DUMMY & VEHICLE INTERIOR - VIEW 1

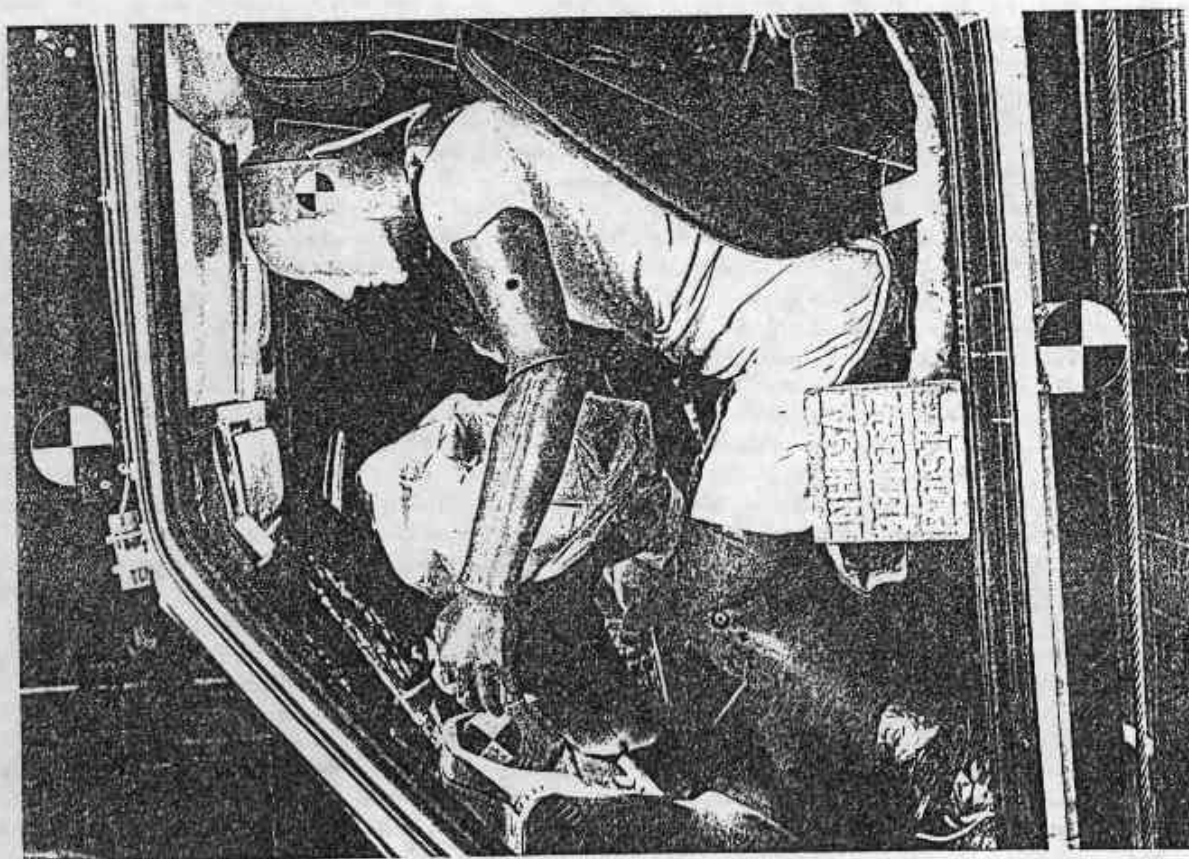


Figure A-10. POST-TEST DRIVER DUMMY & VEHICLE INTERIOR - VIEW 1

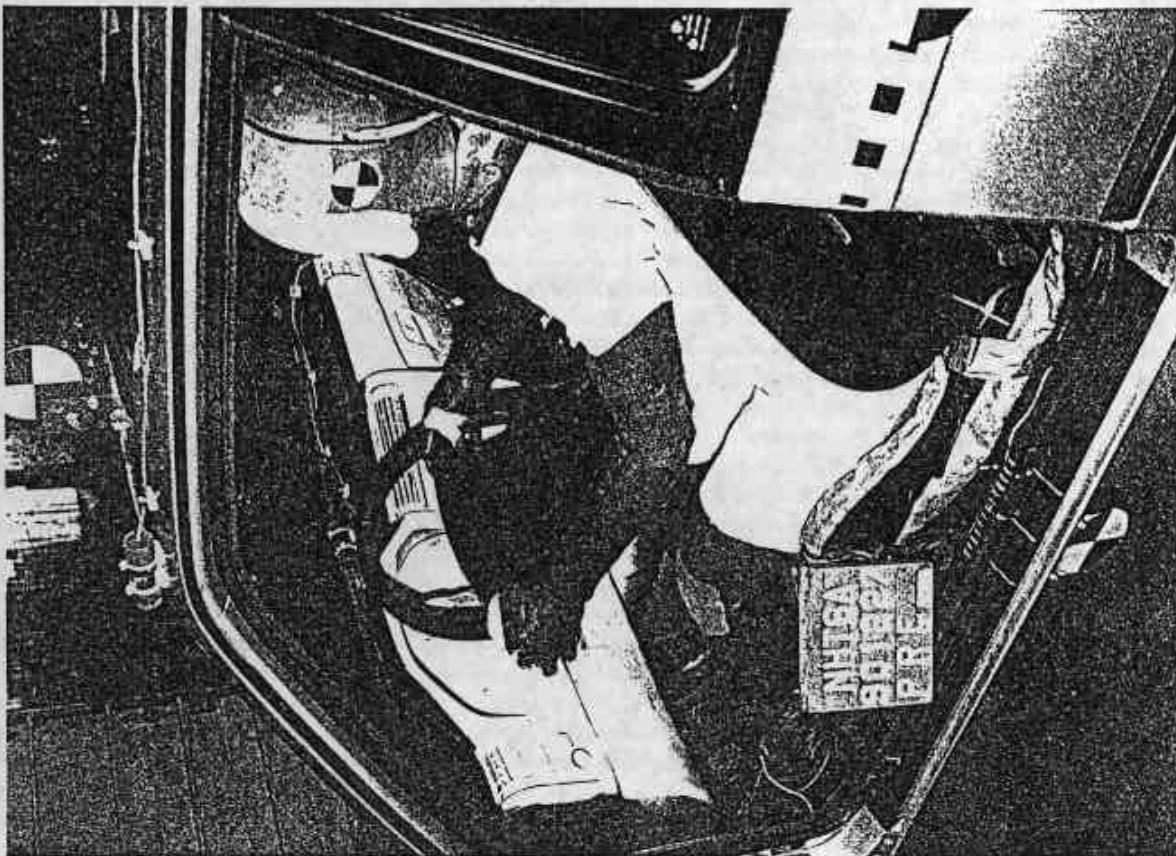


Figure A-31. PRE-TEST DRIVER DUMMY & VEHICLE INTERIOR - VIEW 2

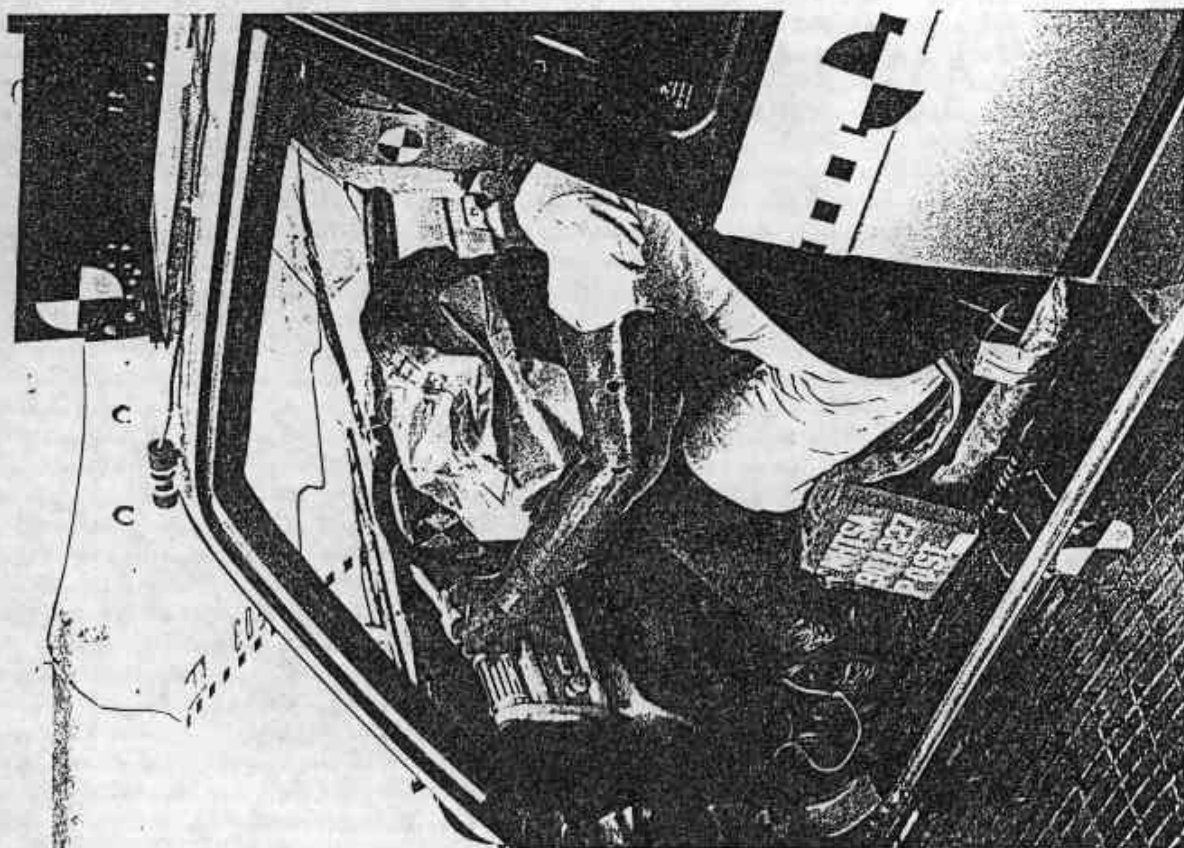


Figure A-32. POST-TEST PASSENGER DUMMY & VEHICLE INTERIOR - VIEW 2

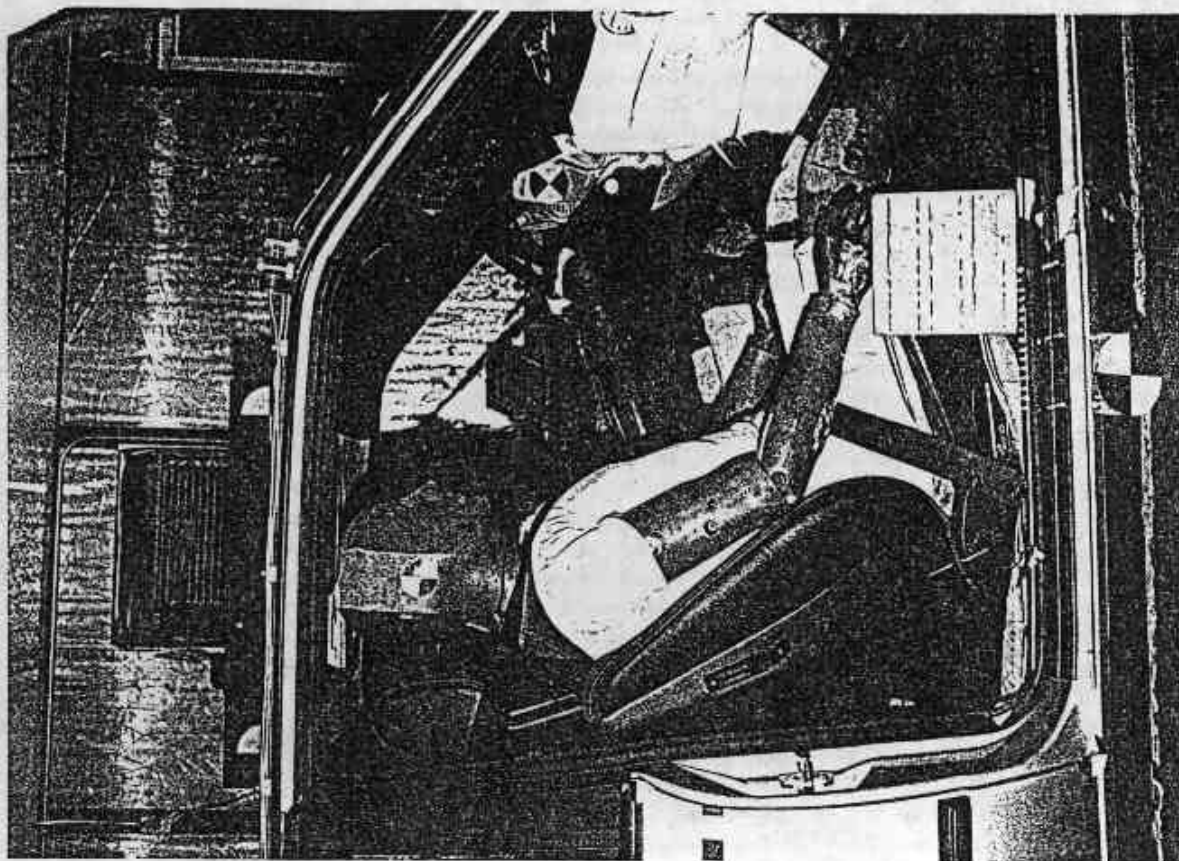


Figure A-33. PRE-TEST PASSENGER DUMMY & VEHICLE INTERIOR - VIEW 1

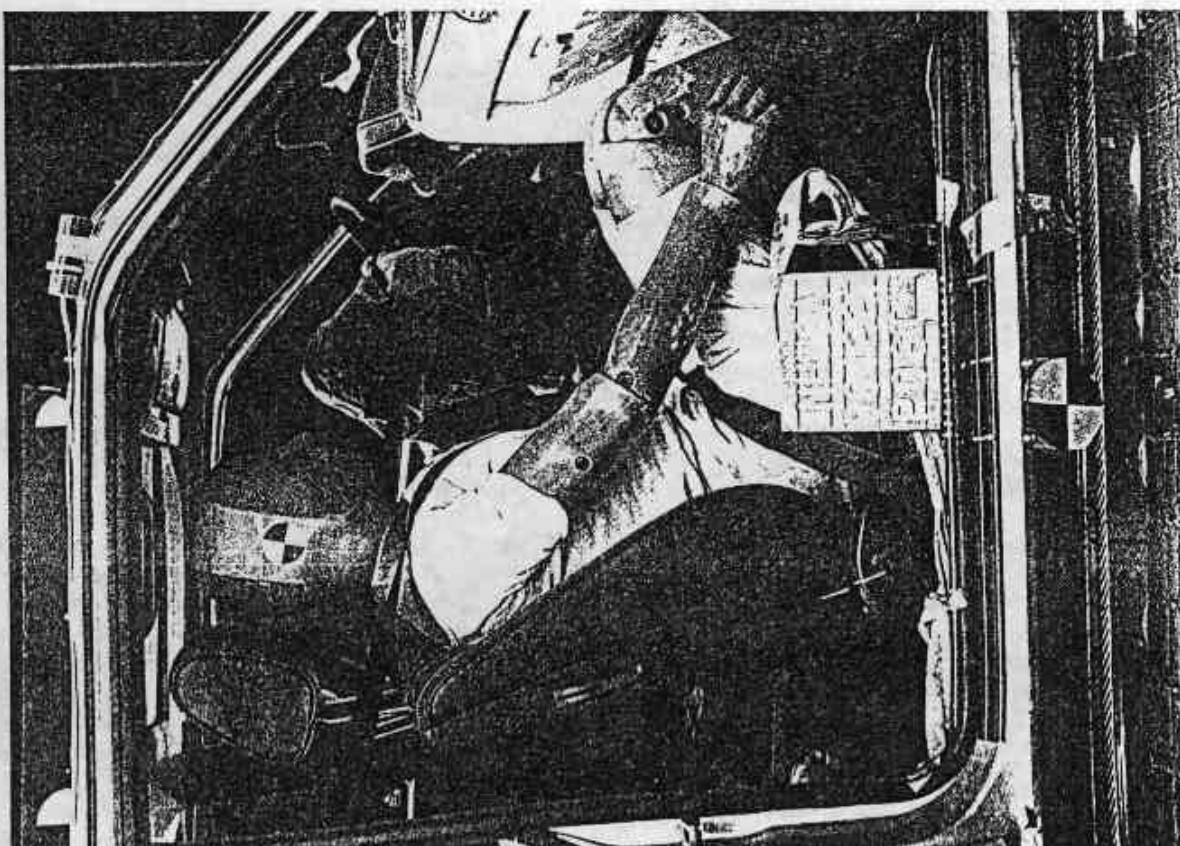


Figure A-34. POST-TEST PASSENGER DUMMY & VEHICLE INTERIOR - VIEW 1



Figure A-35. PRE-TEST PASSENGER DUMMY & VEHICLE INTERIOR - VIEW 2



Figure A-36. POST TEST PASSENGER DUMMY & VEHICLE INTERIOR - VIEW 2



Figure A-37. POST-TEST DRIVER DUMMY HEAD CONTACT - VIEW 1

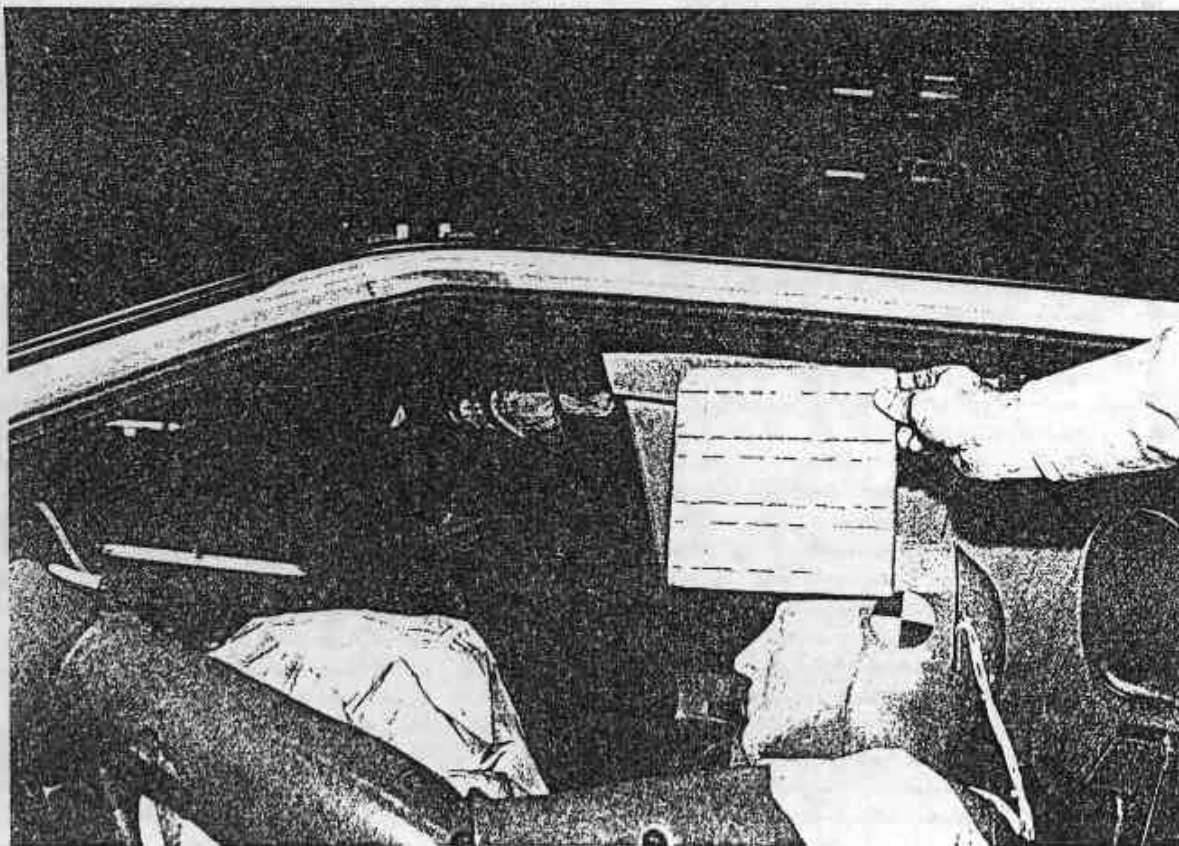


Figure A-38. POST-TEST DRIVER DUMMY HEAD CONTACT - VIEW 2



Figure A-39. POST-TEST DRIVER DUMMY HEAD CONTACT - VIEW 3

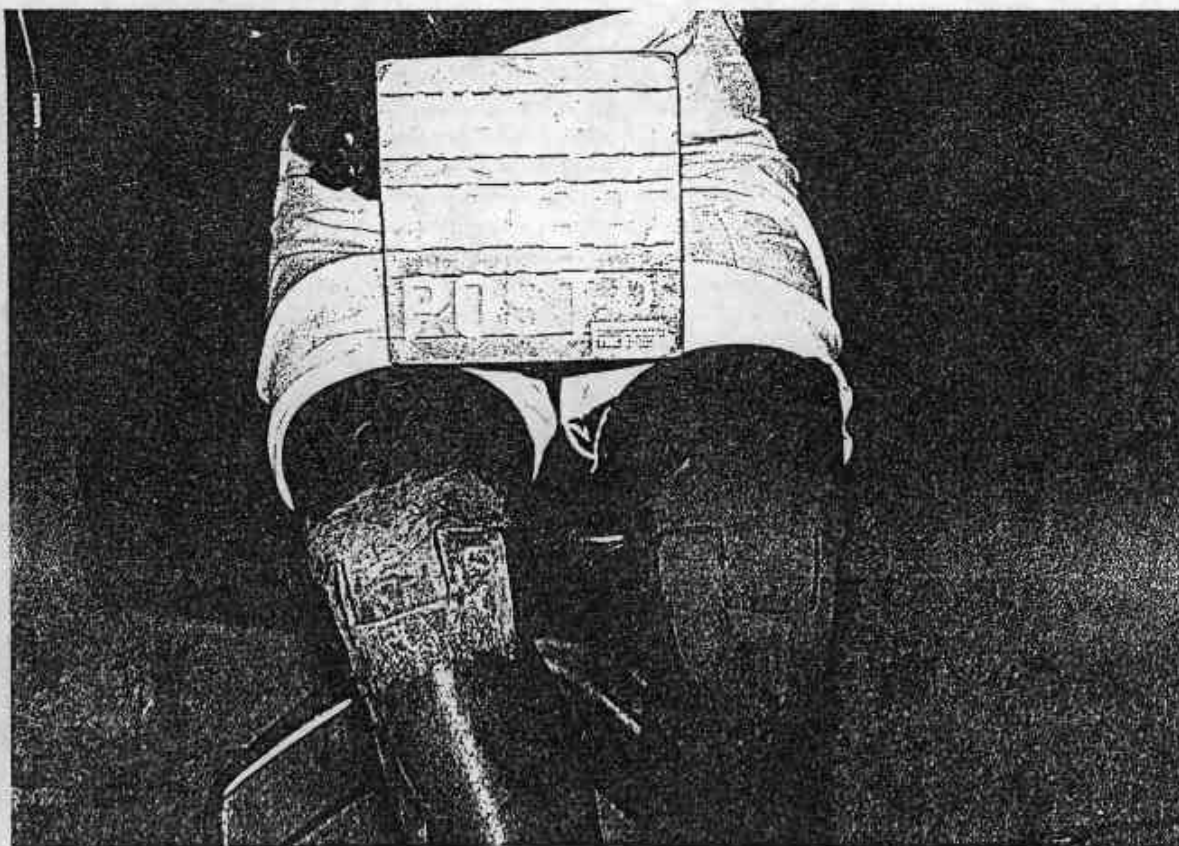


Figure A-40. POST-TEST DRIVER DUMMY KNEE CONTACT- VIEW 1



Figure A-41. POST-TEST DRIVER DUMMY KNEE CONTACT - VIEW 2



Figure A-42. POST TEST PASSENGER DUMMY HEAD CONTACT VIEW



Figure A-43. POST-TEST PASSENGER DUMMY KNEE CONTACT - VIEW 1



Figure A-44. POST-TEST PASSENGER DUMMY KNEE CONTACT - VIEW 2



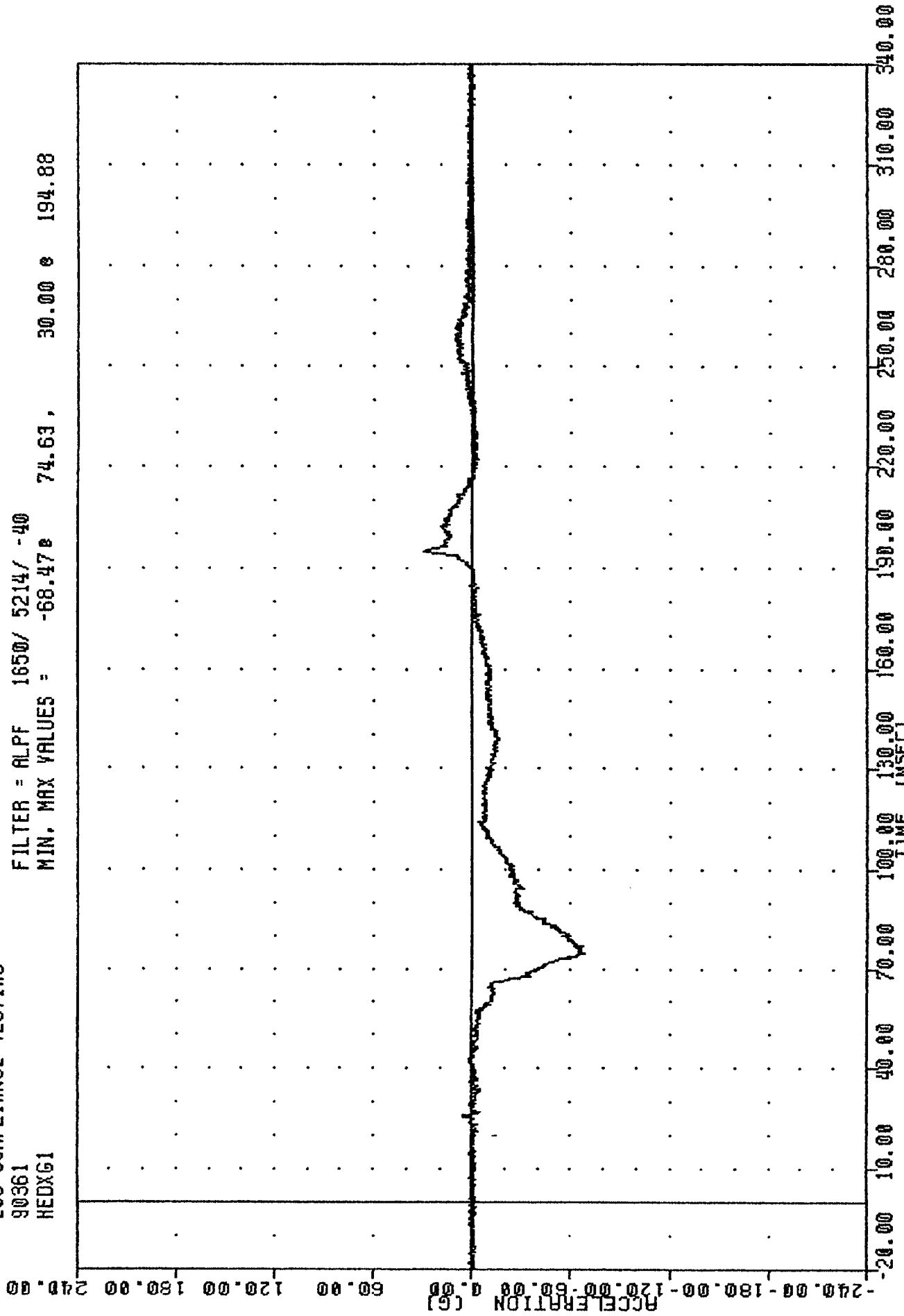
901227

APPENDIX B

DATA PLOTS

TRC , 901227
 200 COMPLIANCE TESTING
 90361
 HEDXG1

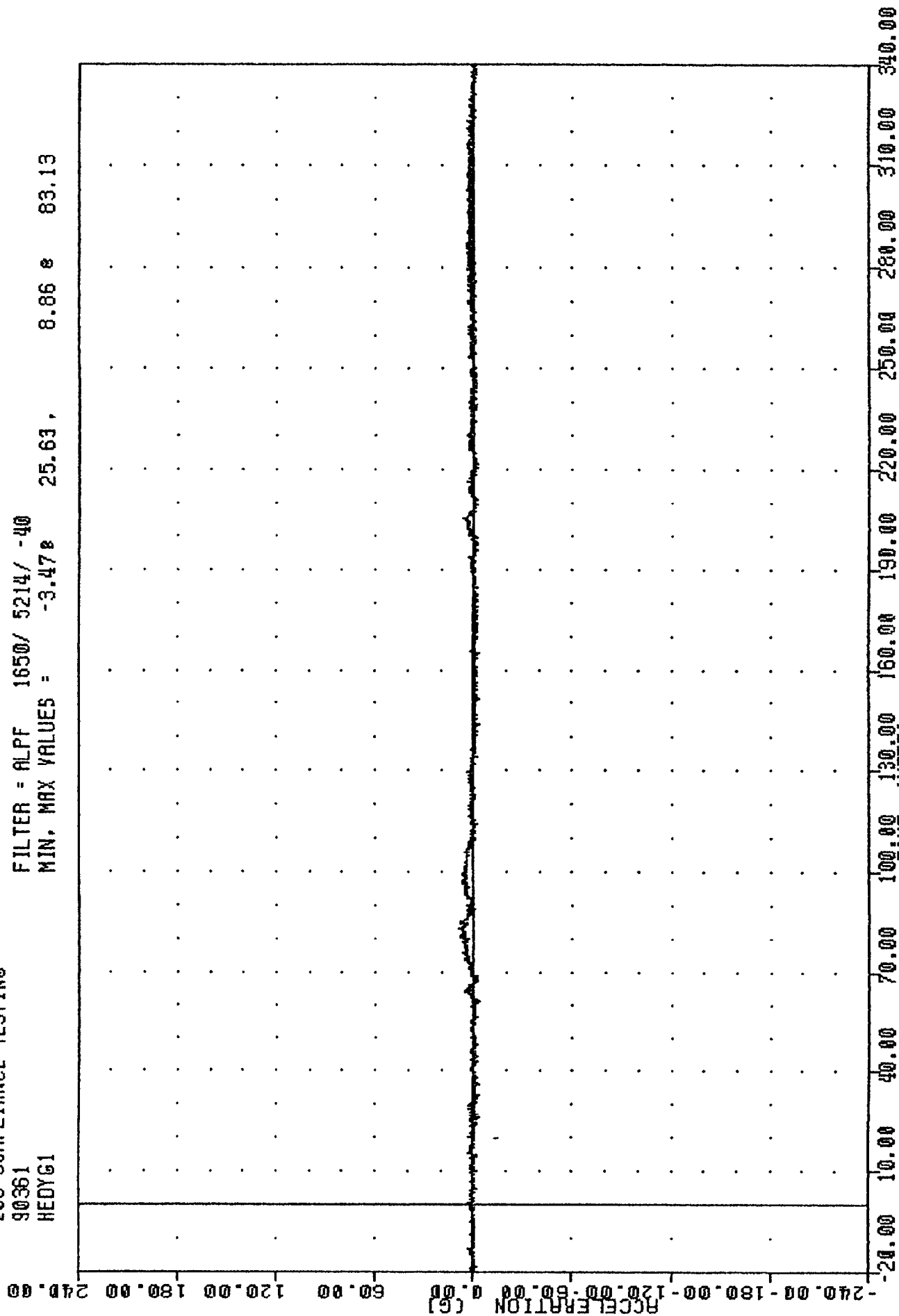
FILTER = ALPF 1650/ 5214/ -40
 MIN, MAX VALUES = -68.478 74.63, 30.00 194.88



1991 BMW 318IS INTO FLAT FRONTAL BARRIER
 DRIVER HEAD X-AXIS ACCELERATION

TRC , 901227
 208 COMPLIANCE TESTING
 90361
 HEDYG1

FILTER = ALPF 1650/ 5214/ -40
 MIN. MAX VALUES = -3.47 25.63 8.86 83.13



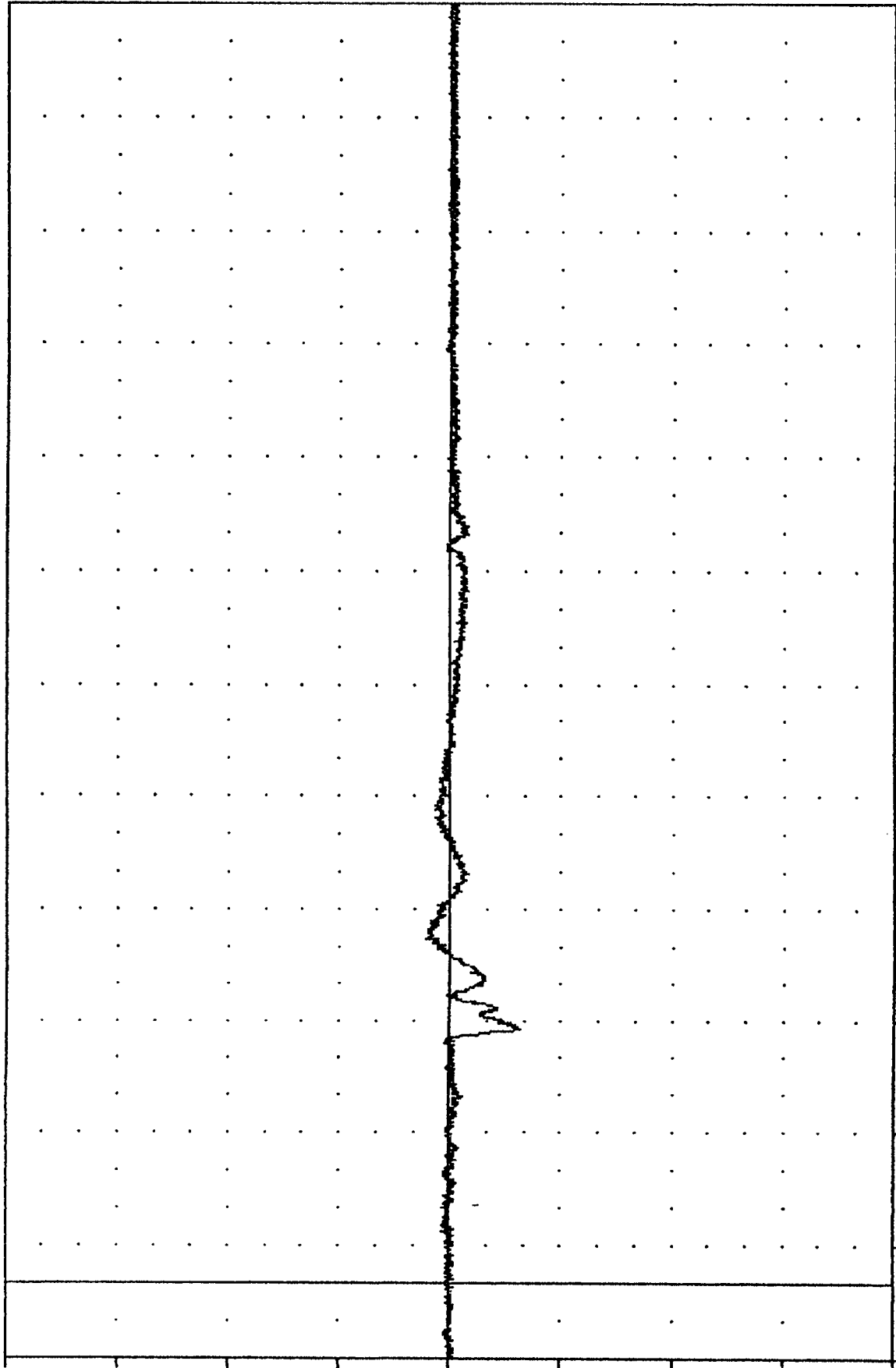
1991 BMW 318iS INTO FLAT FRONTAL BARRIER
 DRIVER HEAD Y-AXIS ACCELERATION

TRC , 901227
208 COMPLIANCE TESTING

90361
HEDZ61

FILTER = ALPF 1650/ 5214/ -40
MIN. MAX VALUES = -38.16 67.88 , 12.72 92.13

ACCELERATION (G)



-240.00 180.00 120.00 60.00 0.00 60.00 120.00 180.00 240.00

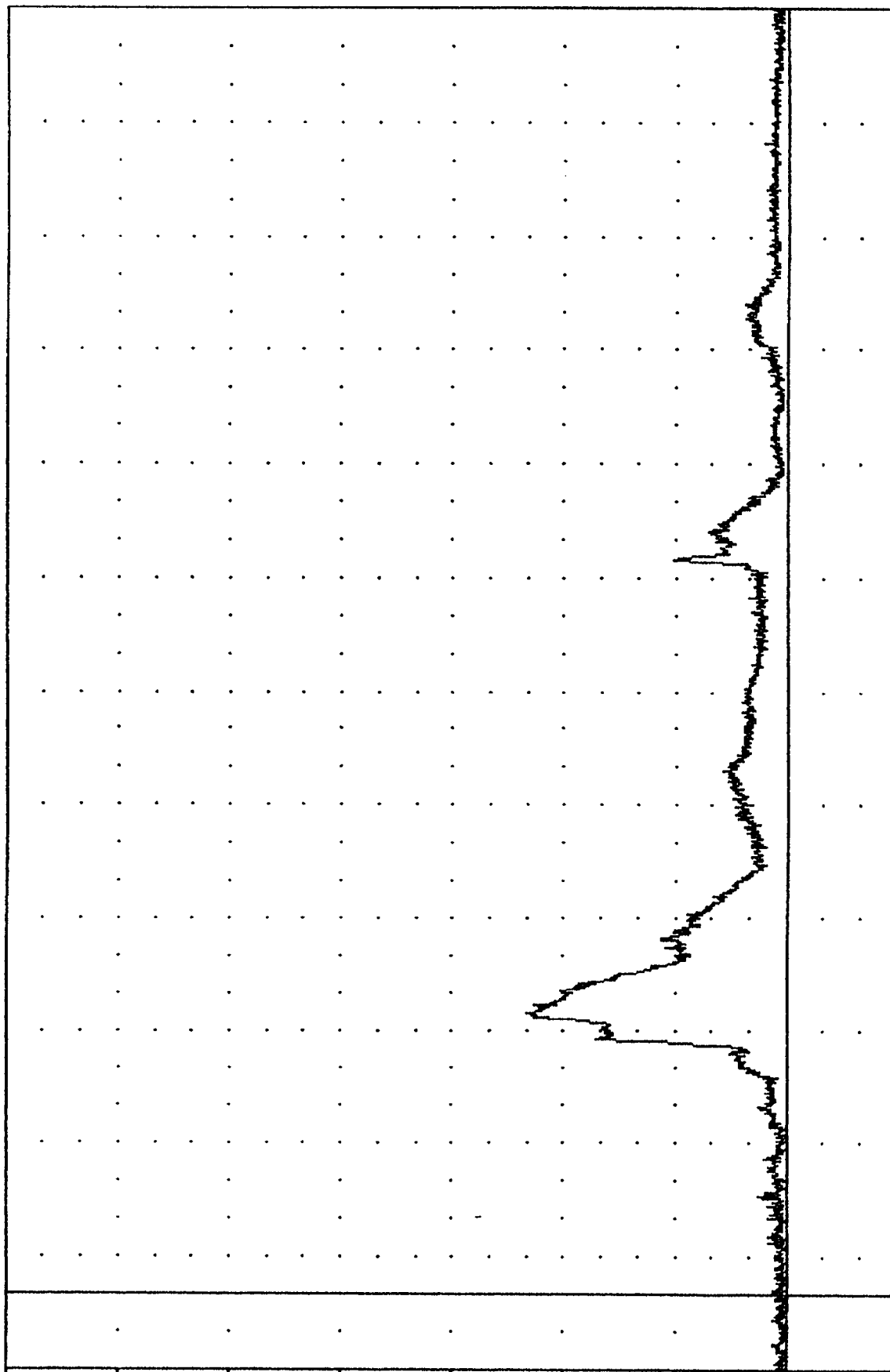
0.00 10.00 20.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 100.00 110.00 120.00 130.00 140.00 150.00 160.00 170.00 180.00 190.00 200.00 210.00 220.00 230.00 240.00 250.00 260.00 270.00 280.00 290.00 300.00 310.00 320.00 330.00 340.00

1991 BMW 318IS INTO FLAT FRONTAL BARRIER
DRIVER HEAD Z-AXIS ACCELERATION

TRC 901227
 208 COMPLIANCE TESTING
 90361
 HEDRG1

FILTER = ALPF 1650/ 5214/ -40
 MIN, MAX VALUES = 0.178 0.88, 70.04 74.63

ACCELERATION (G)
 -30.00 210.00

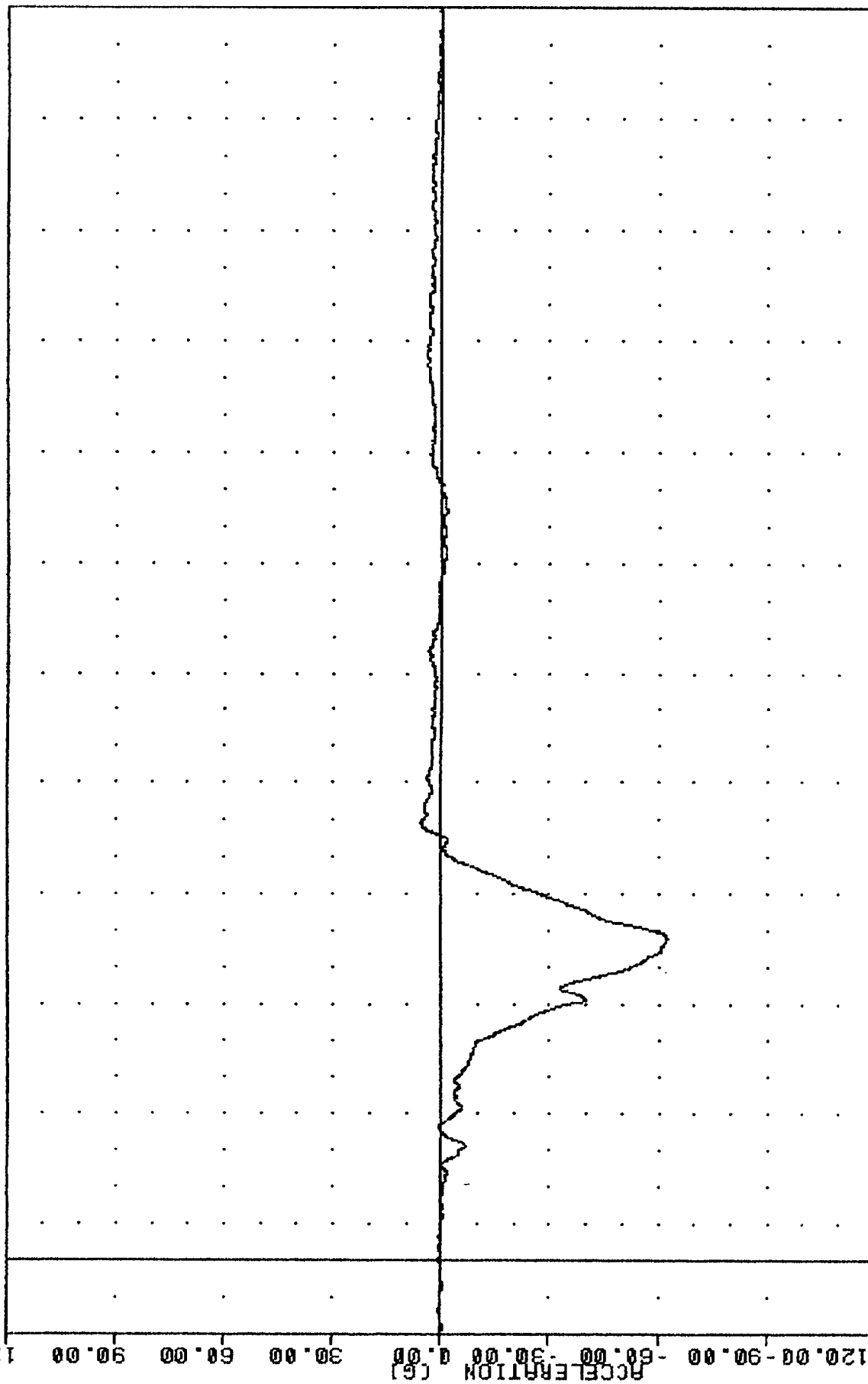


1991 BMW 318IS INTO FLAT FRONTAL BARRIER
 DRIVER HEAD RESULTANT ACCELERATION

TRC , 901227
 208 COMPLIANCE TESTING
 90361
 CSTXG1

FILTER = BLPP 300/ 750/ -16
 MIN, MAX VALUES = -62.54e 87.88, 5.58 e 119.00

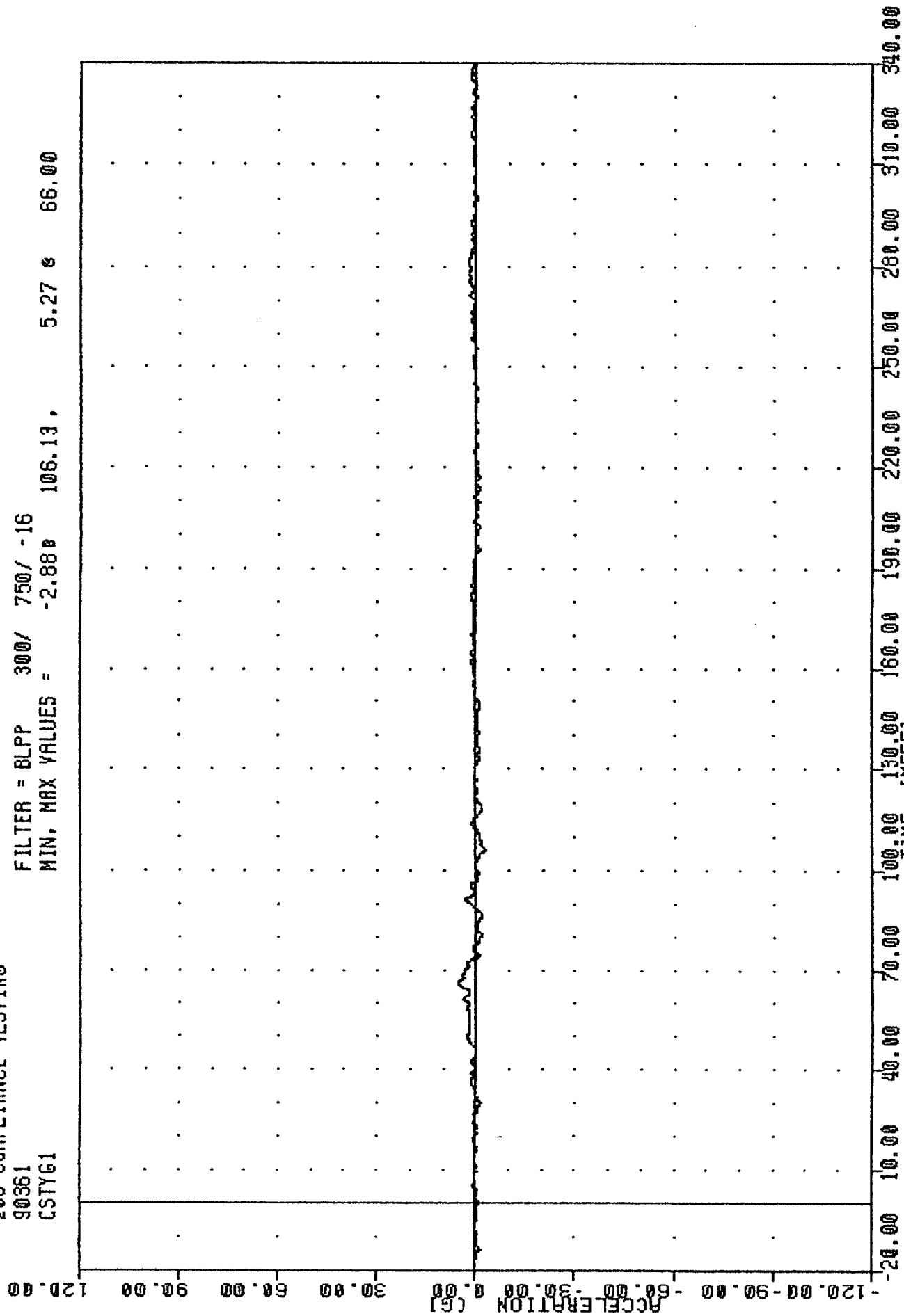
120.00



1991 BMW 318IS INTO FLAT FRONTAL BARRIER
 DRIVER CHEST X-AXIS ACCELERATION

TRC 901227
208 COMPLIANCE TESTING
90361
CSTY61

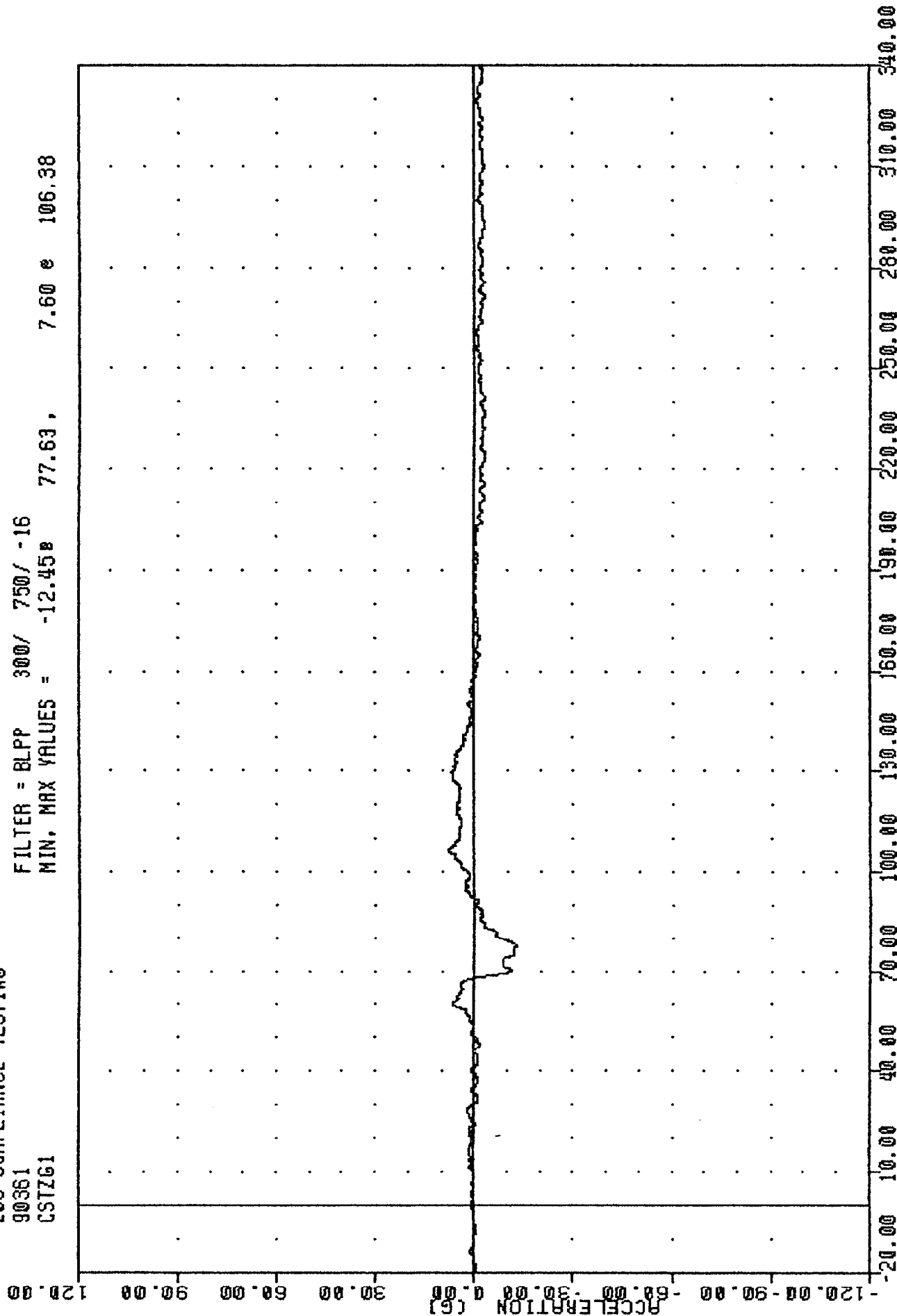
FILTER = BLPP 300/ 750/ -16
MIN, MAX VALUES = -2.880 106.13, 5.27 0 66.00



1991 BMW 318iS INTO FLAT FRONTAL BARRIER
DRIVER CHEST Y-AXIS ACCELERATION

TRC , 901227
 208 COMPLIANCE TESTING
 90361
 CSTZG1

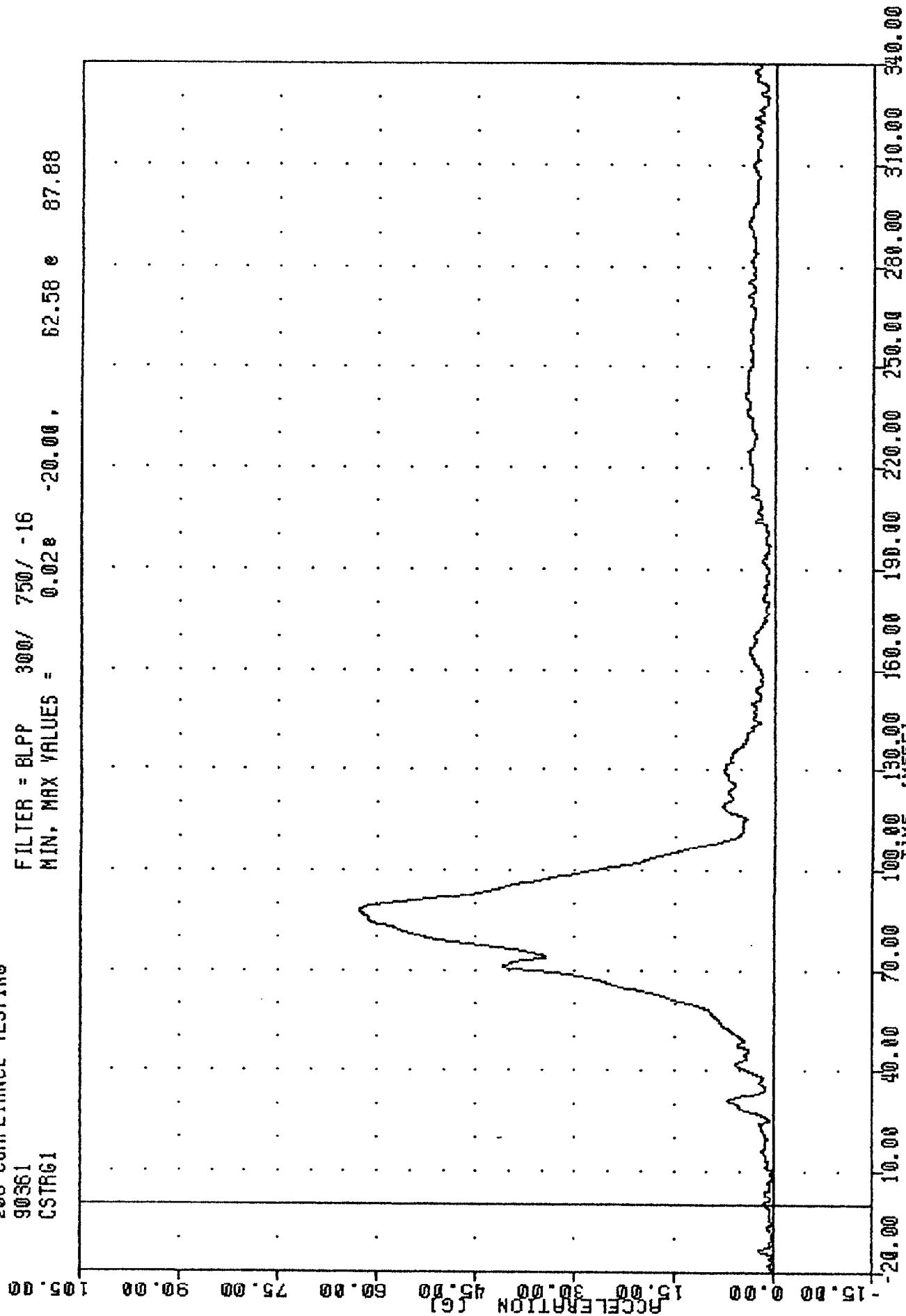
FILTER = BLPP 300/ 750/ -16
 MIN, MAX VALUES = -12.458 77.63, 7.60 e 106.38



1991 BMW 318IS INTO FLAT FRONTAL BARRIER
 DRIVER CHEST Z-AXIS ACCELERATION

TRC , 901227
 200 COMPLIANCE TESTING
 90361
 CSTR61

FILTER = BLPP 300/ 750/ -16
 MIN, MAX VALUES = -20.00, 62.58 e 87.88

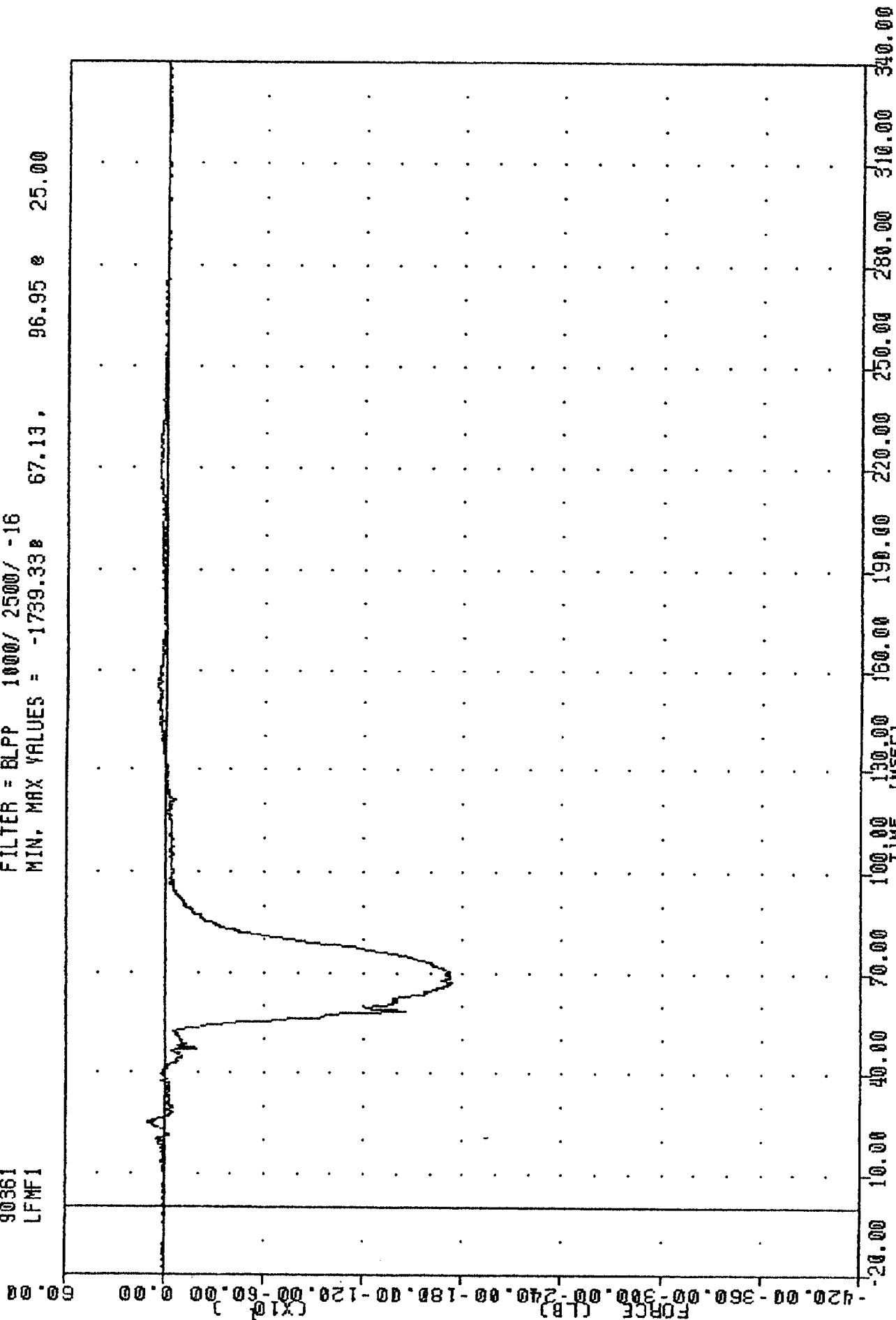


1991 BMW 318IS INTO FLAT FRONTAL BARRIER
 DRIVER CHEST RESULTANT ACCELERATION

TRC
208 COMPLIANCE TESTING
90361
LFMF1

901227

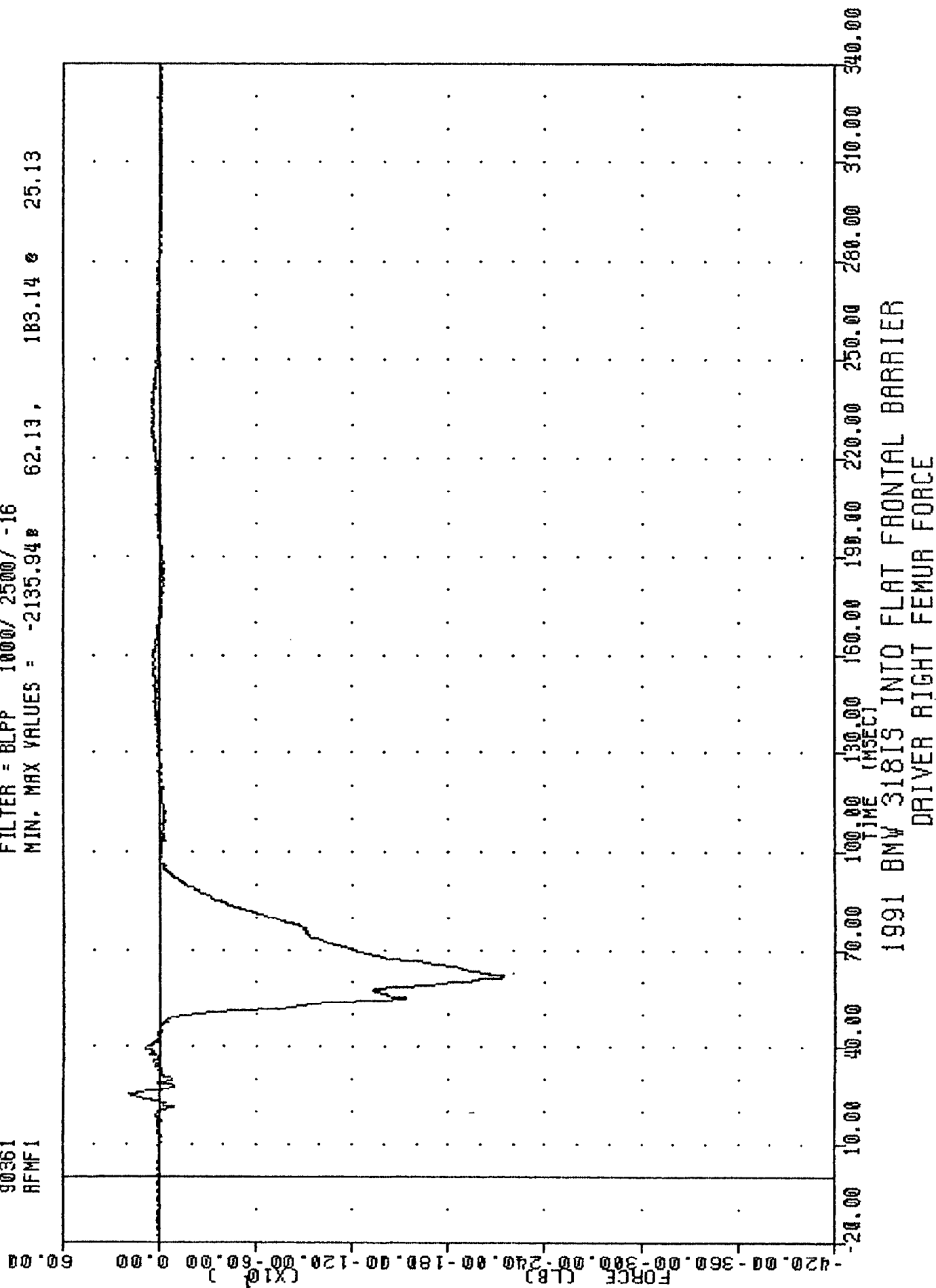
FILTER = BLPP 1000/ 2500/ -16
MIN. MAX VALUES = -1739.33 67.13, 96.95 25.00



1991 BMW 318iS INTO FLAT FRONTAL BARRIER
DRIVER LEFT FEMUR FORCE

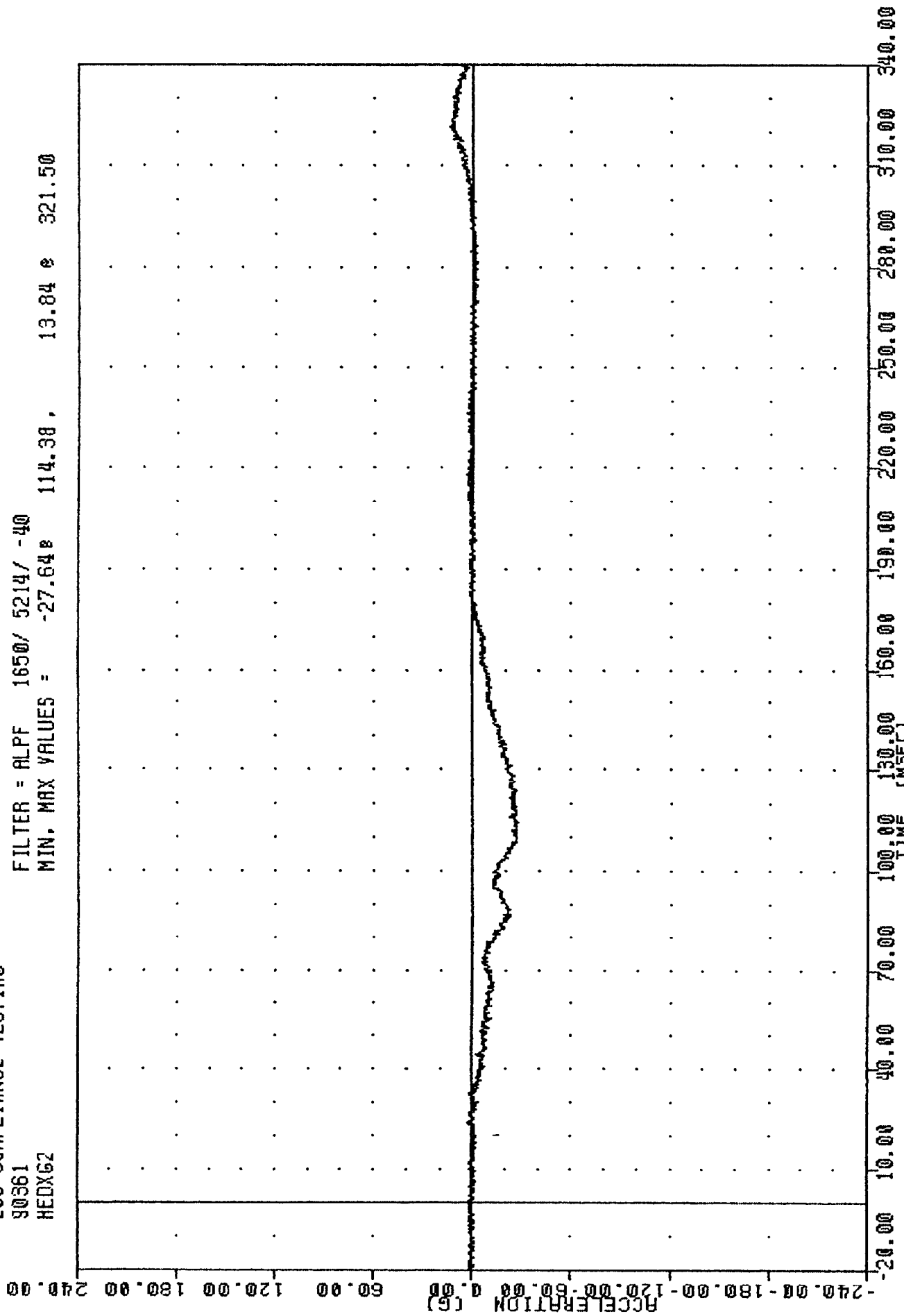
TRC , 901227
 208 COMPLIANCE TESTING
 90361
 AFMF1

FILTER = BLPP 1000/ 2500/ -16
 MIN. MAX VALUES = -2135.94 62.13, 183.14 25.13



TRC , 901227
 200 COMPLIANCE TESTING
 90361
 HEDX62

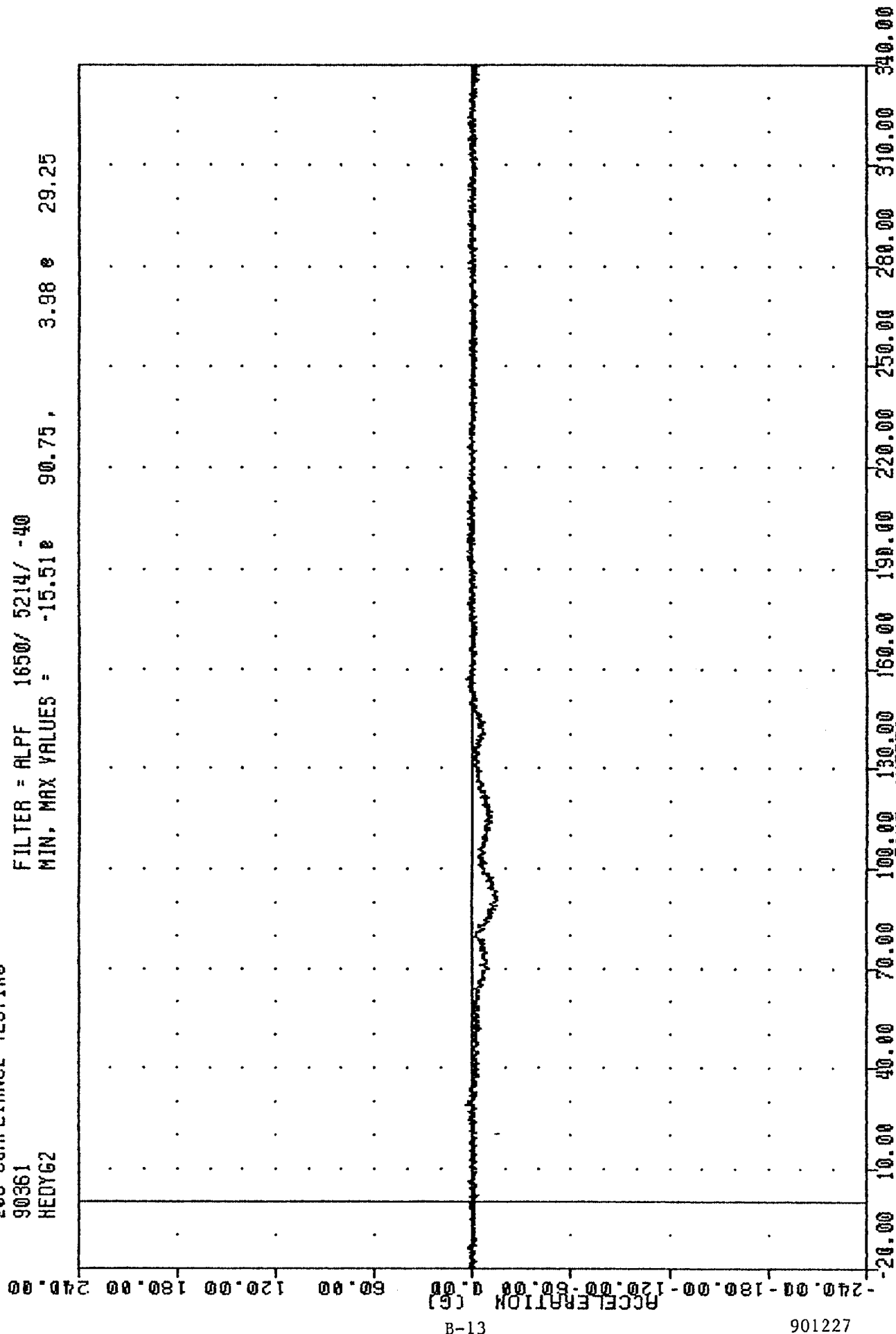
FILTER = ALPF 1650/ 5214/ -40
 MIN, MAX VALUES = -27.648 114.38, 13.84 & 321.50



1991 BMW 318IS INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER HEAD X-AXIS ACCELERATION

TRC , 901227
 208 COMPLIANCE TESTING
 90361
 HEDY62

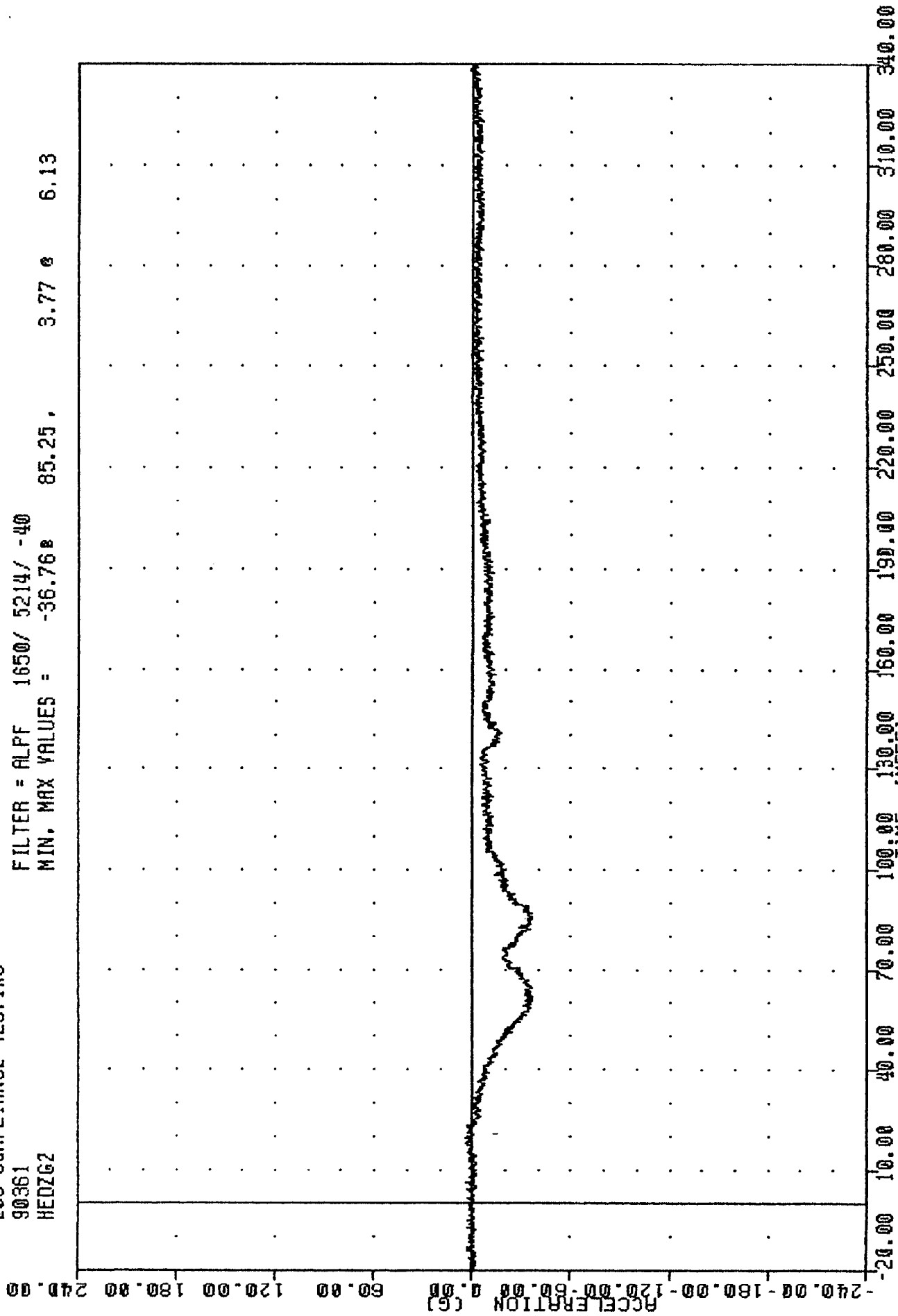
FILTER = ALPF 1650/ 5214/ -40
 MIN, MAX VALUES = -15.51e 90.75, 3.98 e 29.25



1991 BMW 318IS INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER HEAD Y-AXIS ACCELERATION

TRC , 901227
 208 COMPLIANCE TESTING
 90361
 HEDZG2

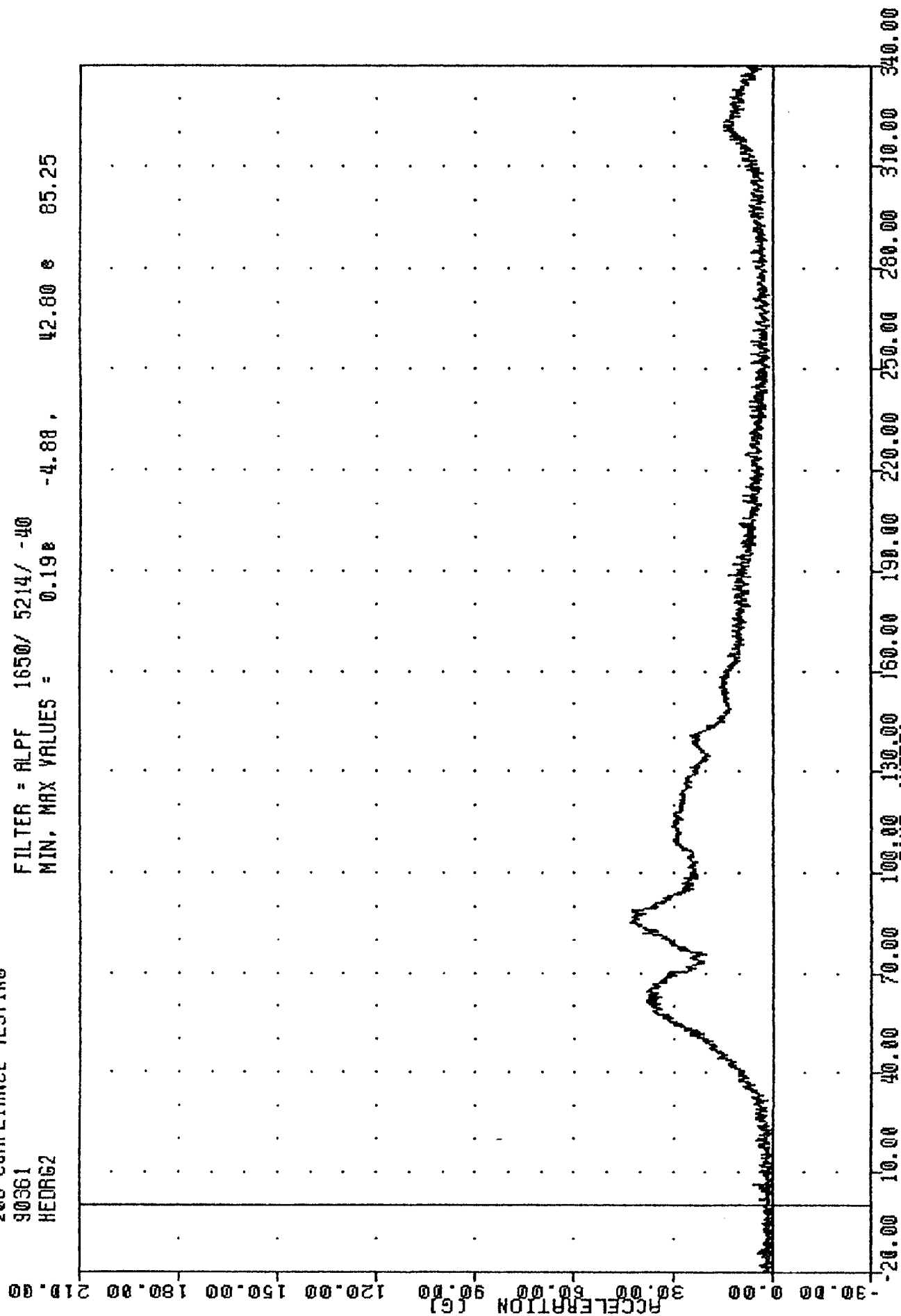
FILTER = ALPF 1650/ 5214/ -40
 MIN, MAX VALUES = -36.76 85.25, 3.77 6.13



1991 BMW 318IS INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER HEAD Z-AXIS ACCELERATION

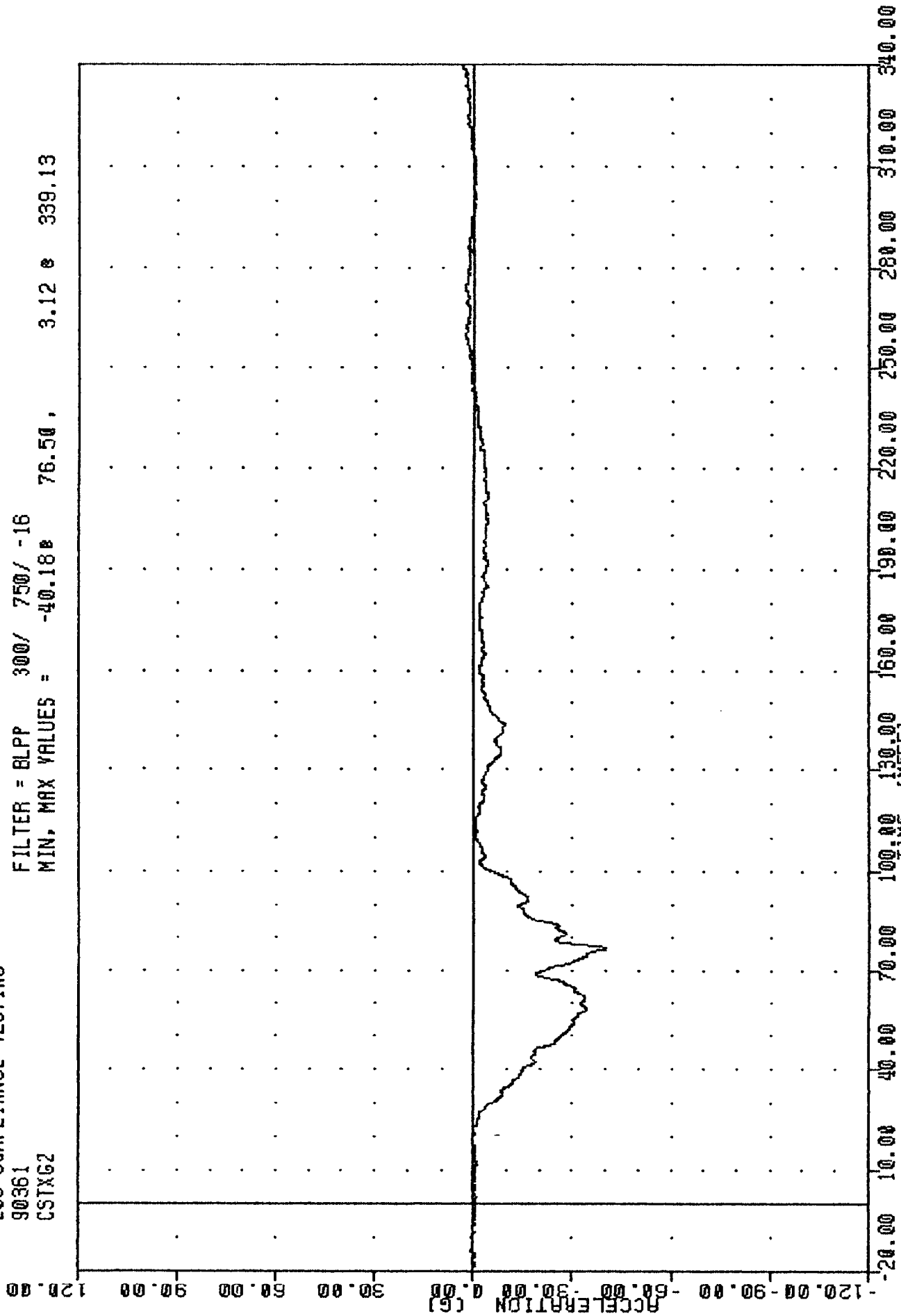
TRC , 901227
 208 COMPLIANCE TESTING
 90361
 HEAD62

FILTER = ALPF 1650/ 5214/ -40
 MIN, MAX VALUES = 0.19e -4.88 , 42.80 e 85.25



TRC , 901227
 200 COMPLIANCE TESTING
 90361
 CSTXG2

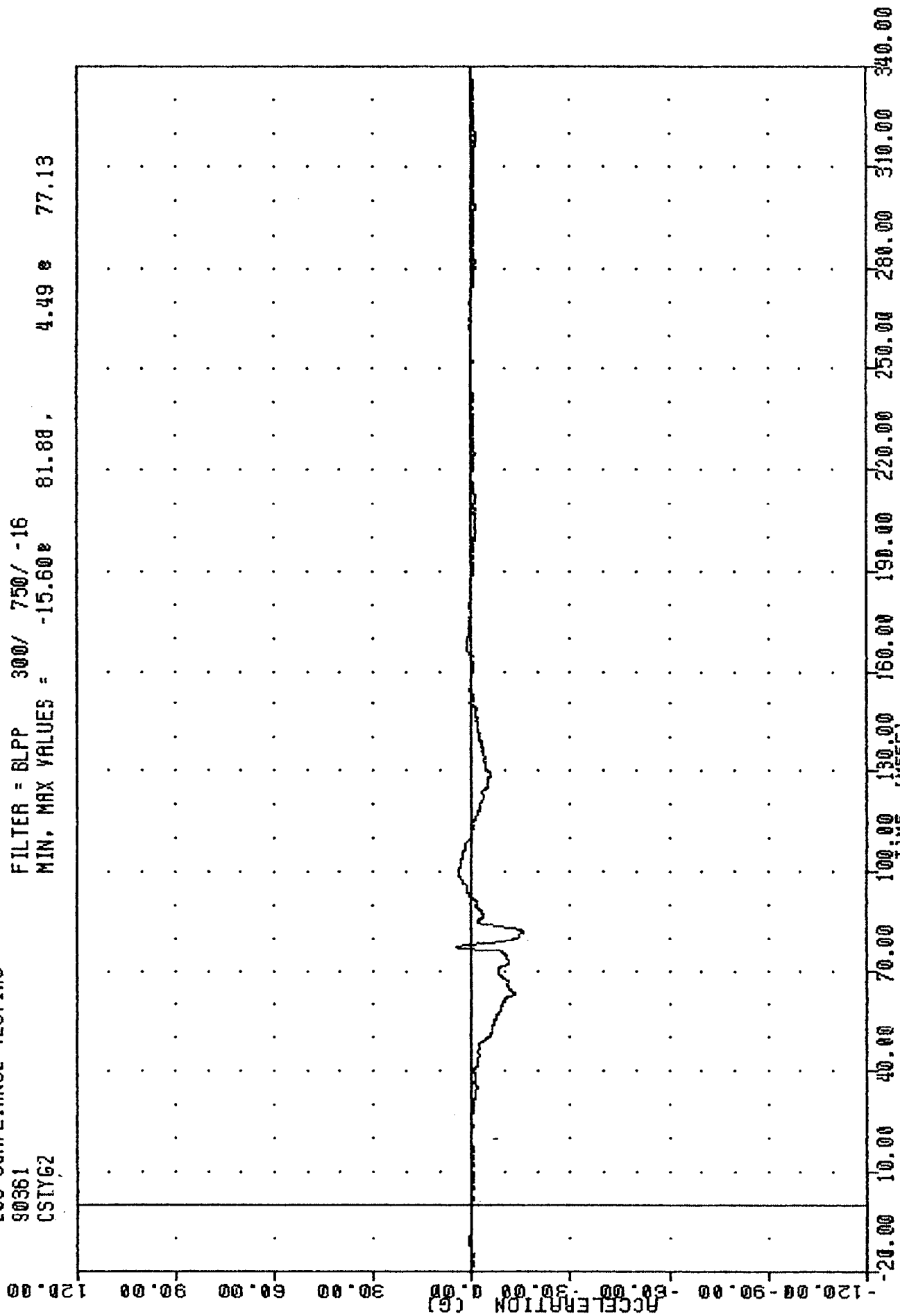
FILTER = BLPP 300/ 750/ -16
 MIN, MAX VALUES = -40.18 76.50, 3.12 339.13



1991 BMW 318IS INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER CHEST X-AXIS ACCELERATION

TRC , 901227
 208 COMPLIANCE TESTING
 90361
 CSTYG2

FILTER = BLPP 300/ 750/ -16
 MIN, MAX VALUES = 81.88 , 4.49 e 77.13

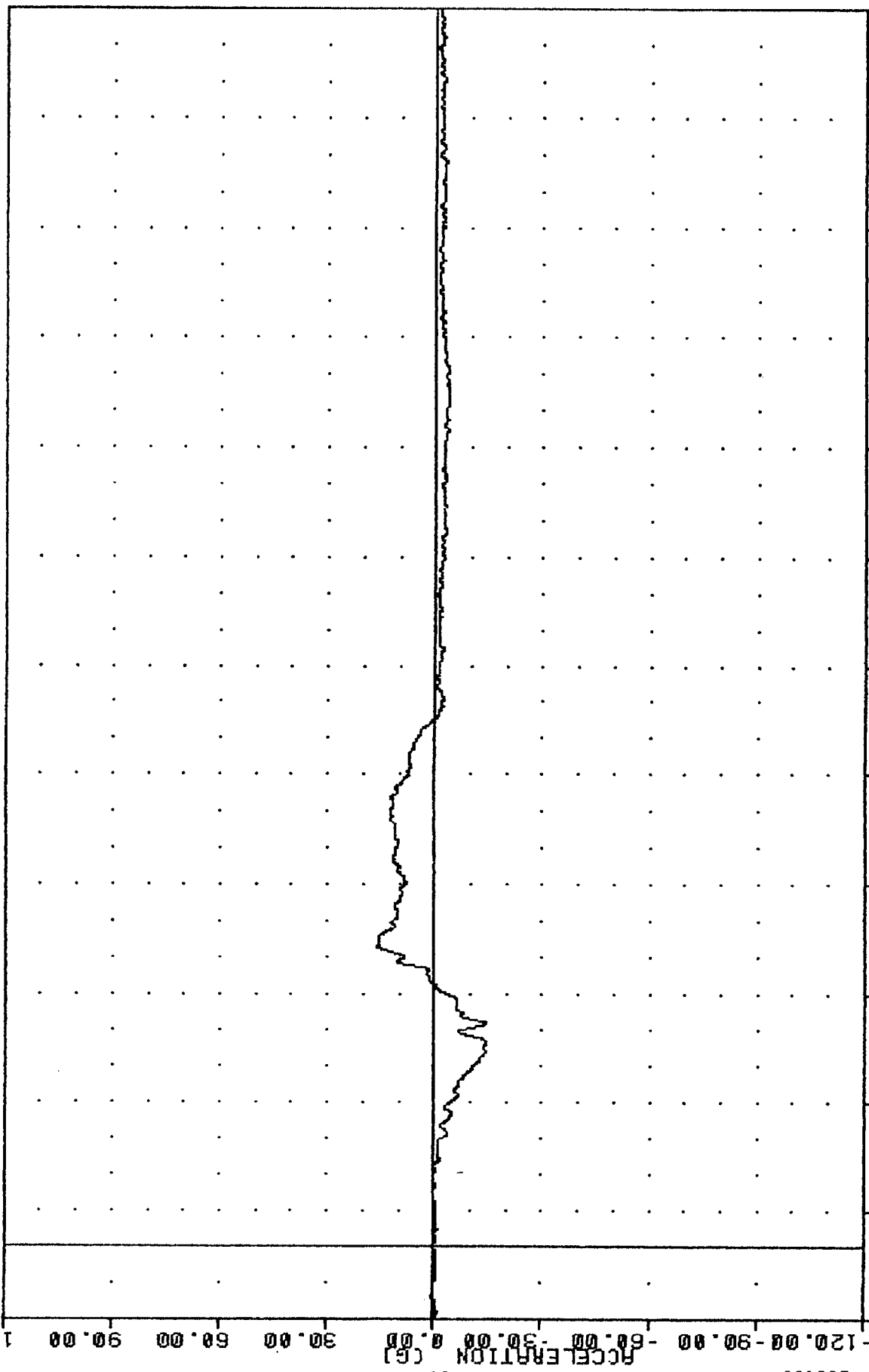


1991 BMW 318IS INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER CHEST Y-AXIS ACCELERATION

TRC , 901227
 208 COMPLIANCE TESTING
 90361
 CSTZG2

FILTER = BLPP 300/ 750/ -16
 MIN, MAX VALUES = -14.458 61.88, 15.95 8 82.88

120.00



B-18

901227

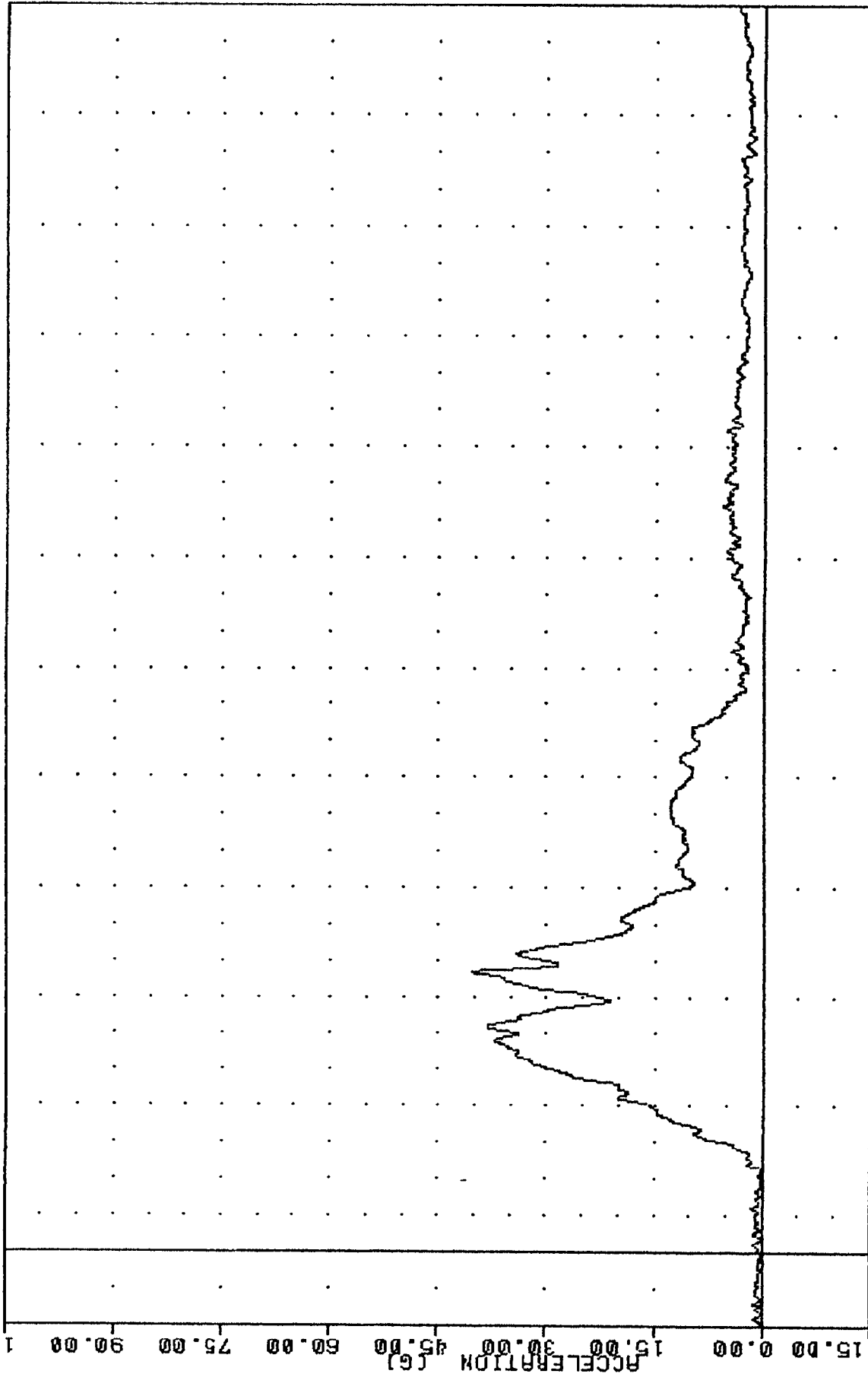
-20.00 10.00 40.00 70.00 100.00 130.00 160.00 190.00 220.00 250.00 280.00 310.00 340.00

1991 BMW 318IS INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER CHEST Z-AXIS ACCELERATION

TRC , 901227
 208 COMPLIANCE TESTING
 90361
 CSTRG2

FILTER = BLPP 300/ 750/ -16
 MIN, MAX VALUES = 0.03e 18.38, 40.23 e 76.63

105.00

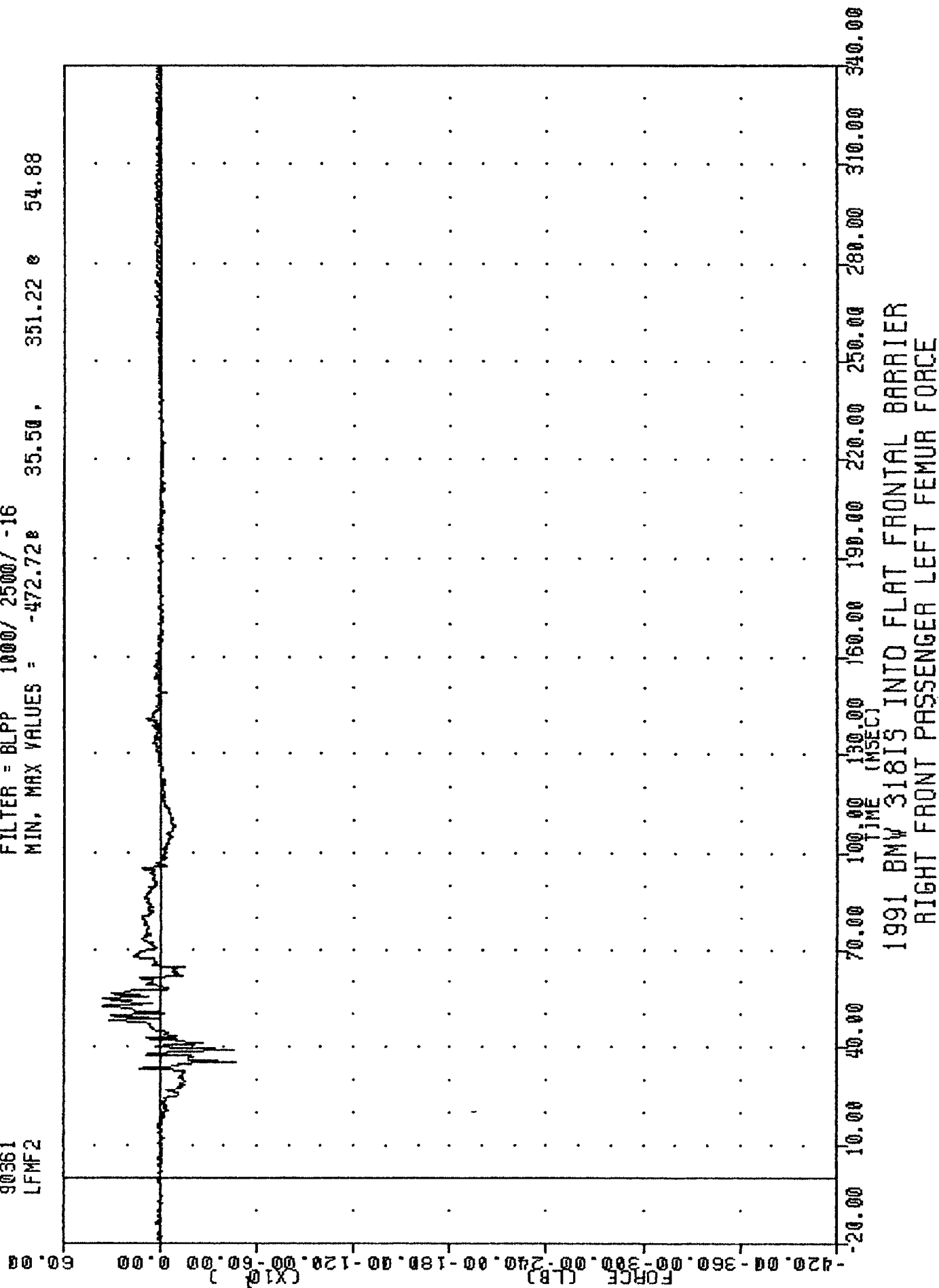


-20.00 10.00 40.00 70.00 100.00 130.00 160.00 190.00 220.00 250.00 280.00 310.00 340.00

1991 BMW 318IS INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER CHEST RESULTANT ACCELERATION

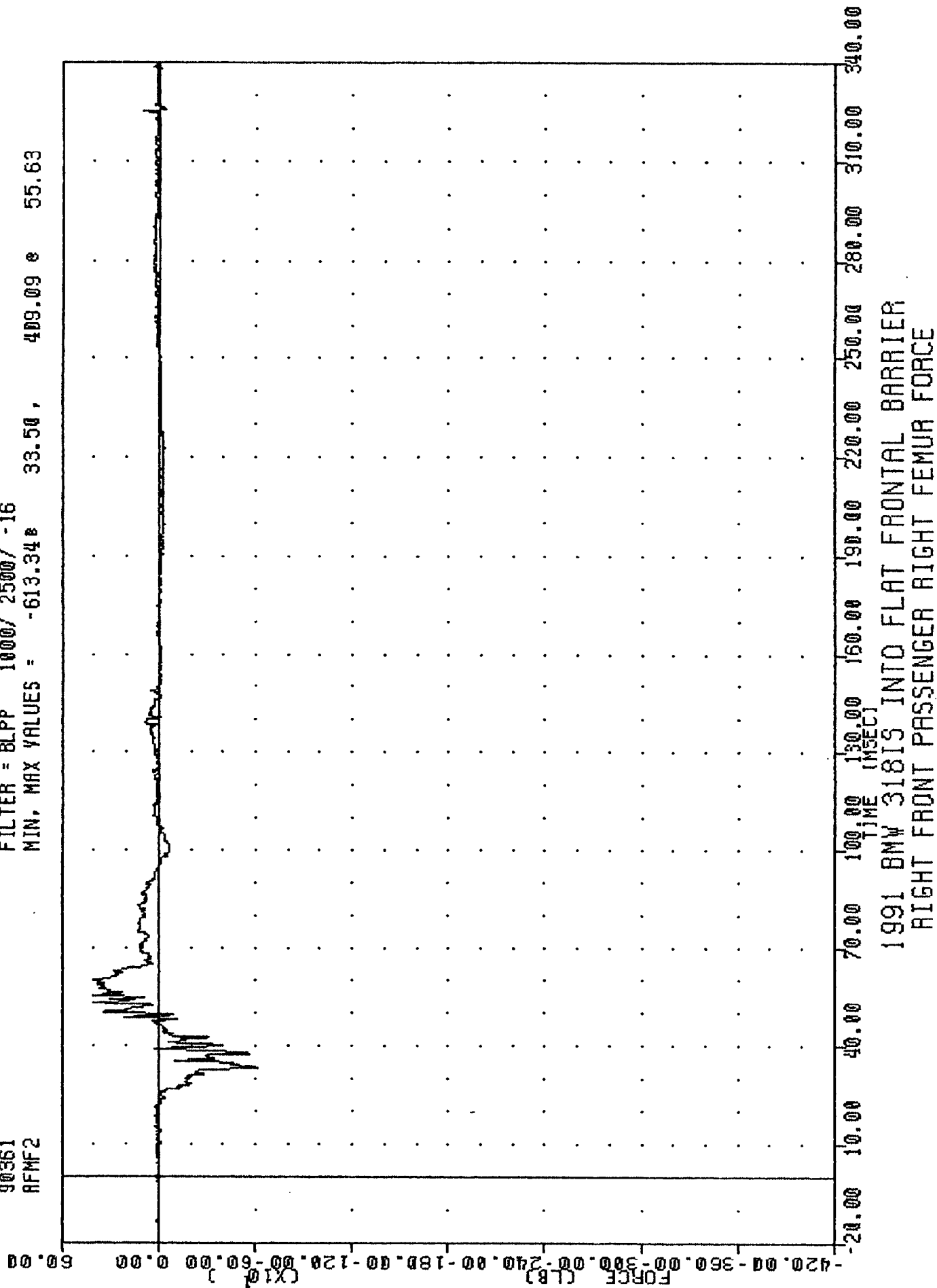
TRC , 901227
 208 COMPLIANCE TESTING
 90361
 LFMF2

FILTER = BLPP 1000/ 2500/ -16
 MIN, MAX VALUES = -472.728 35.50, 351.22 54.88



TRC , 901227
 200 COMPLIANCE TESTING
 90361
 AFMF2

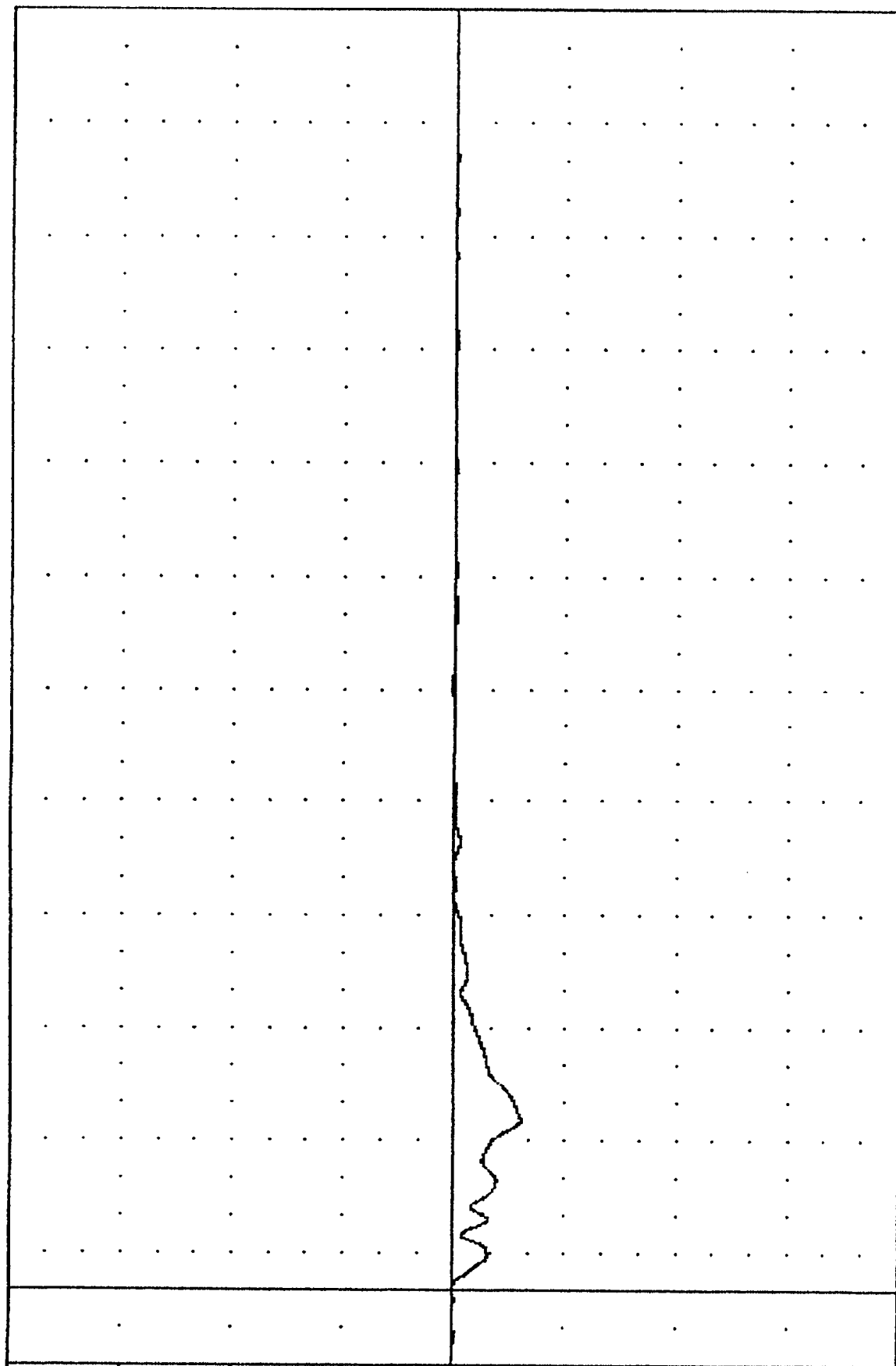
FILTER = BLPP 1000/ 2500/ -16
 MIN, MAX VALUES = -613.348 33.50 , 409.09 e 55.63



TRC , 901227
 208 COMPLIANCE TESTING
 90361
 TLRXG1

FILTER = BLPP 100/ 250/ -16
 MIN, MAX VALUES = -36.168 45.25, 1.45 e 161.25

ACCELERATION (G)

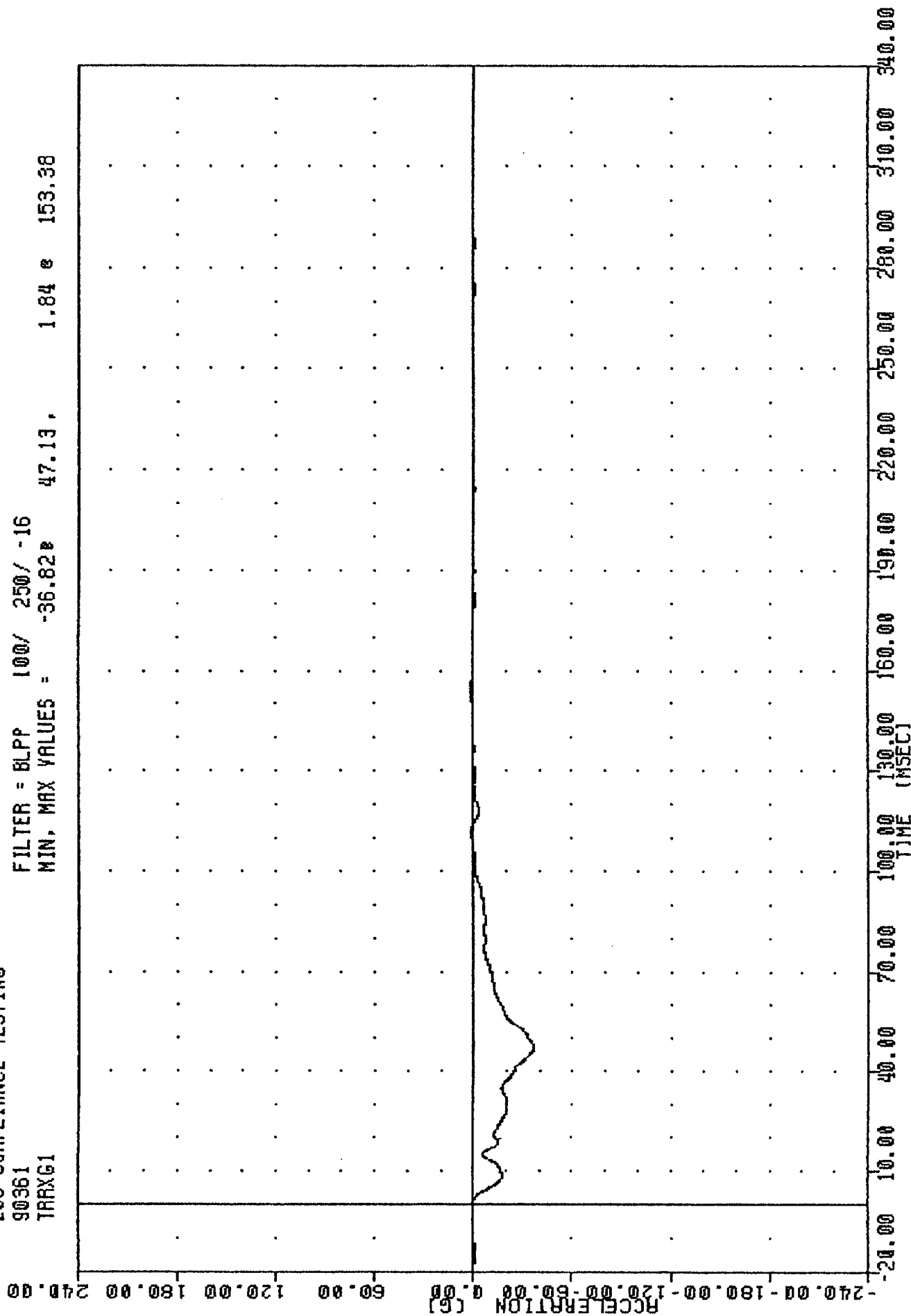


-240.00 10.00 40.00 70.00 100.00 130.00 160.00 190.00 220.00 250.00 280.00 310.00 340.00

1991 BMW 318IS INTO FLAT FRONTAL BARRIER
 LEFT REAR SEAT X-AXIS ACCELERATION

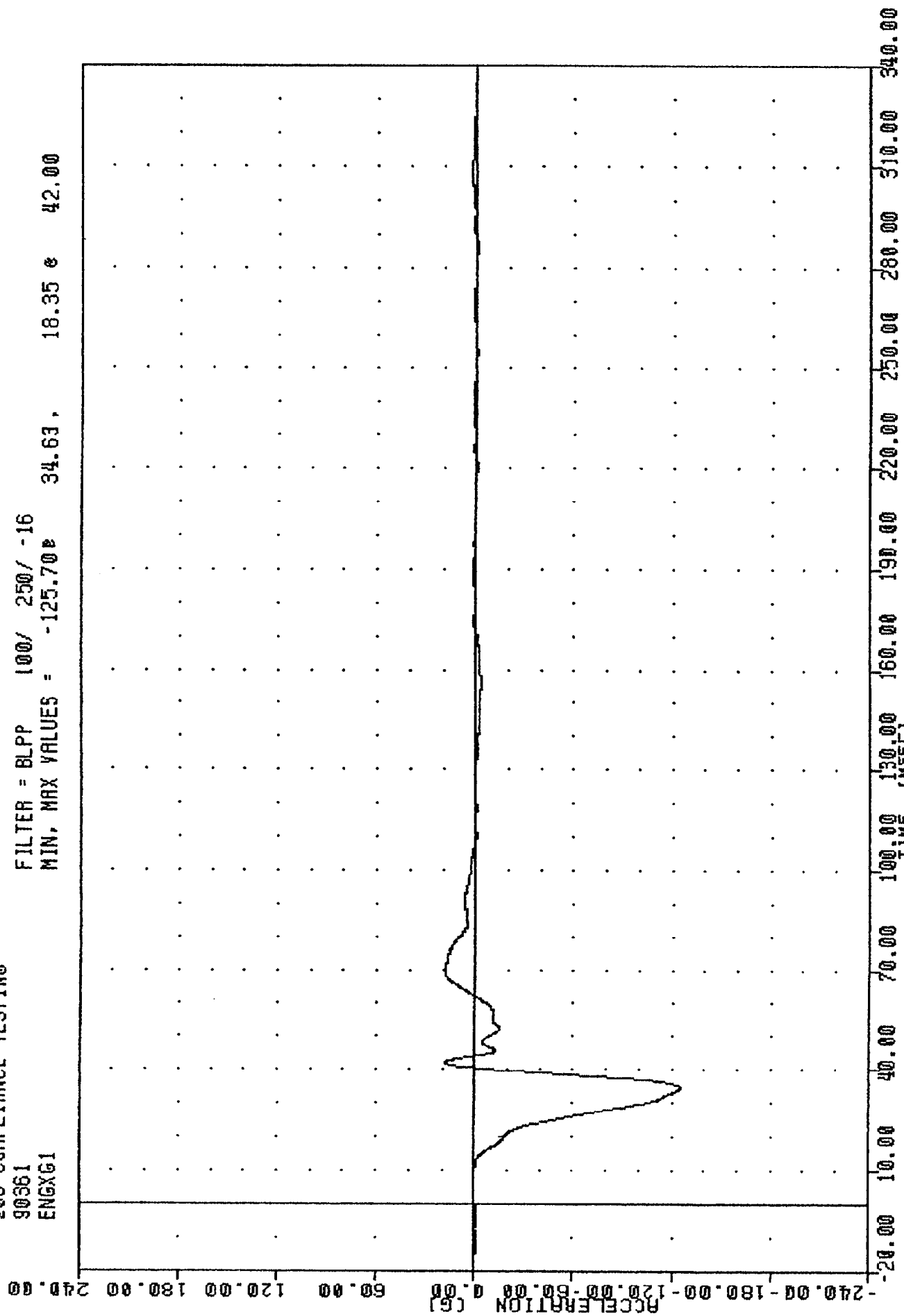
TRC , 901227
 200 COMPLIANCE TESTING
 90361
 TRRXG1

FILTER = BLPP 100/ 250/ -16
 MIN, MAX VALUES = -36.82 47.13, 1.84 153.38



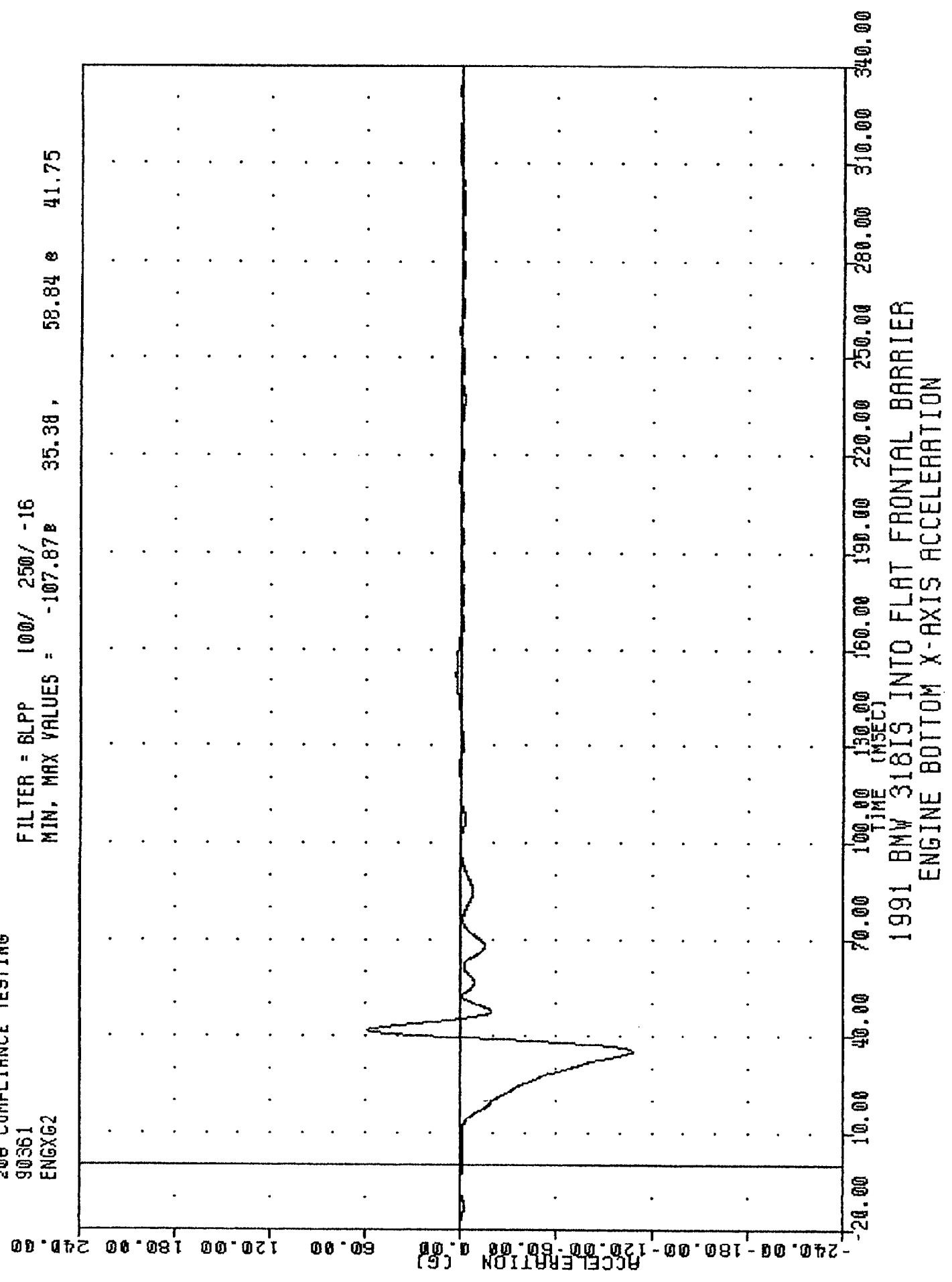
TRC , 901227
 200 COMPLIANCE TESTING
 90361
 ENGCG1

FILTER = BLPP 100/ 250/ -16
 MIN, MAX VALUES = -125.700 34.63, 18.35 & 42.00



TRC , 901227
 200 COMPLIANCE TESTING
 90361
 ENGCG2

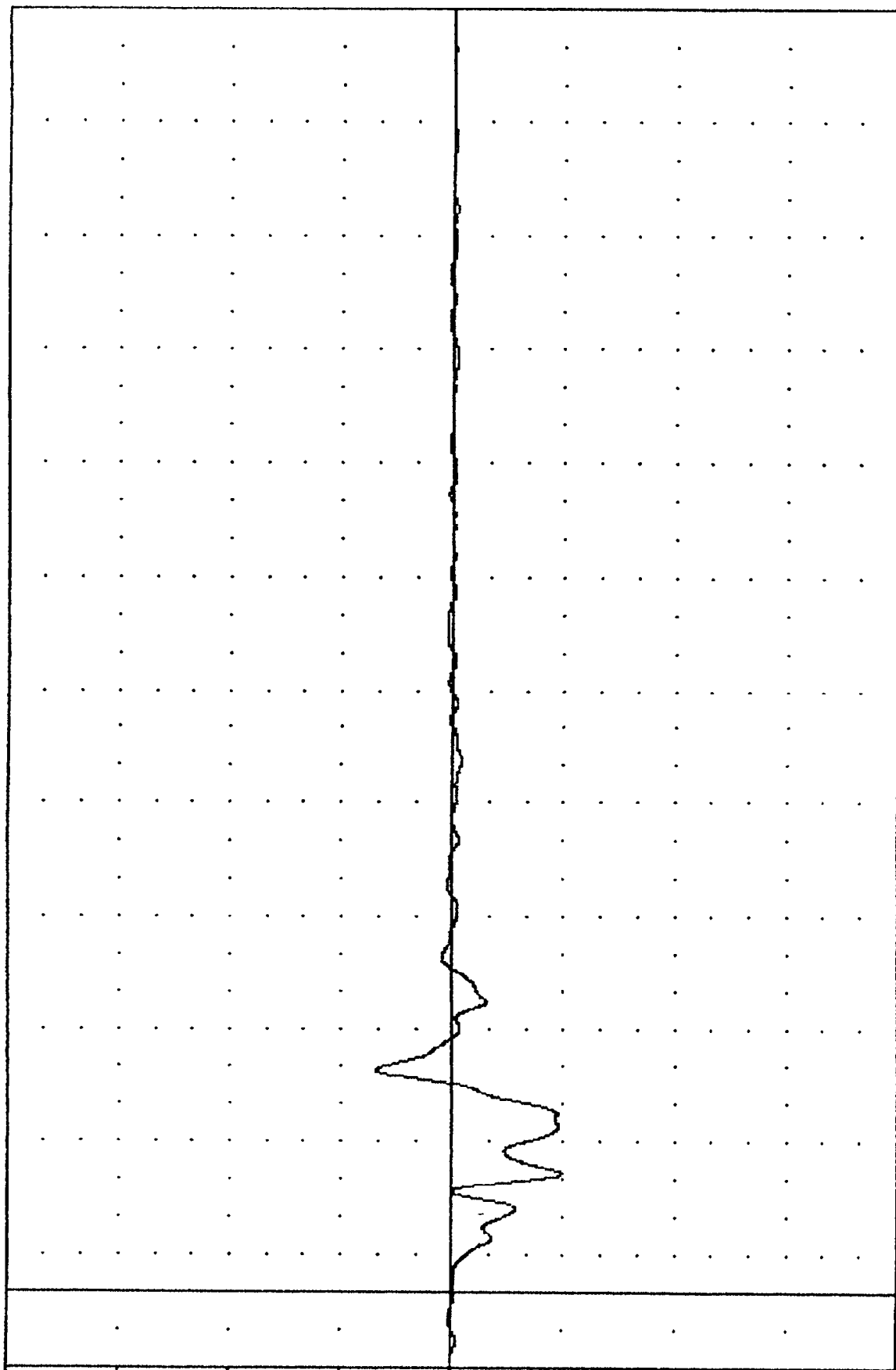
FILTER = 6LPP 100/ 250/ -16
 MIN, MAX VALUES = -107.87 35.38 , 58.84 @ 41.75



TRC 901227
 200 COMPLIANCE TESTING
 90361
 BCRX61

FILTER = BLPP 100/ 250/ -16
 MIN, MAX VALUES = -58.91e 31.63, 40.87 e 59.00

ACCELERATION (G)

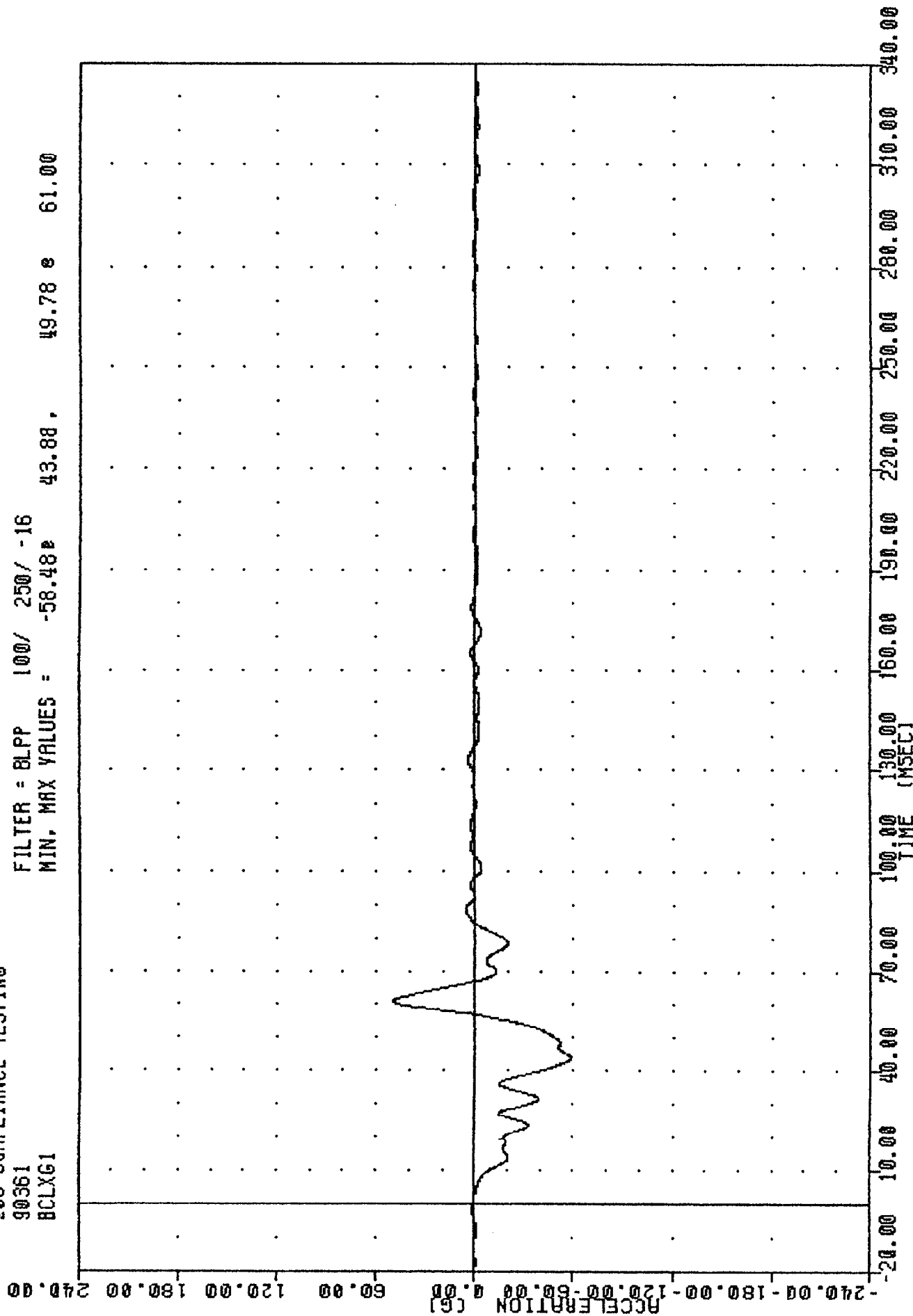


-20.00 10.00 20.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 100.00 110.00 120.00 130.00 140.00 150.00 160.00 170.00 180.00 190.00 200.00 210.00 220.00 230.00 240.00 250.00 260.00 270.00 280.00 290.00 300.00 310.00 320.00 330.00 340.00

1991 BMW 318IS INTO FLAT FRONTAL BARRIER
 RIGHT BRAKE CALIPER X-AXIS ACCELERATION

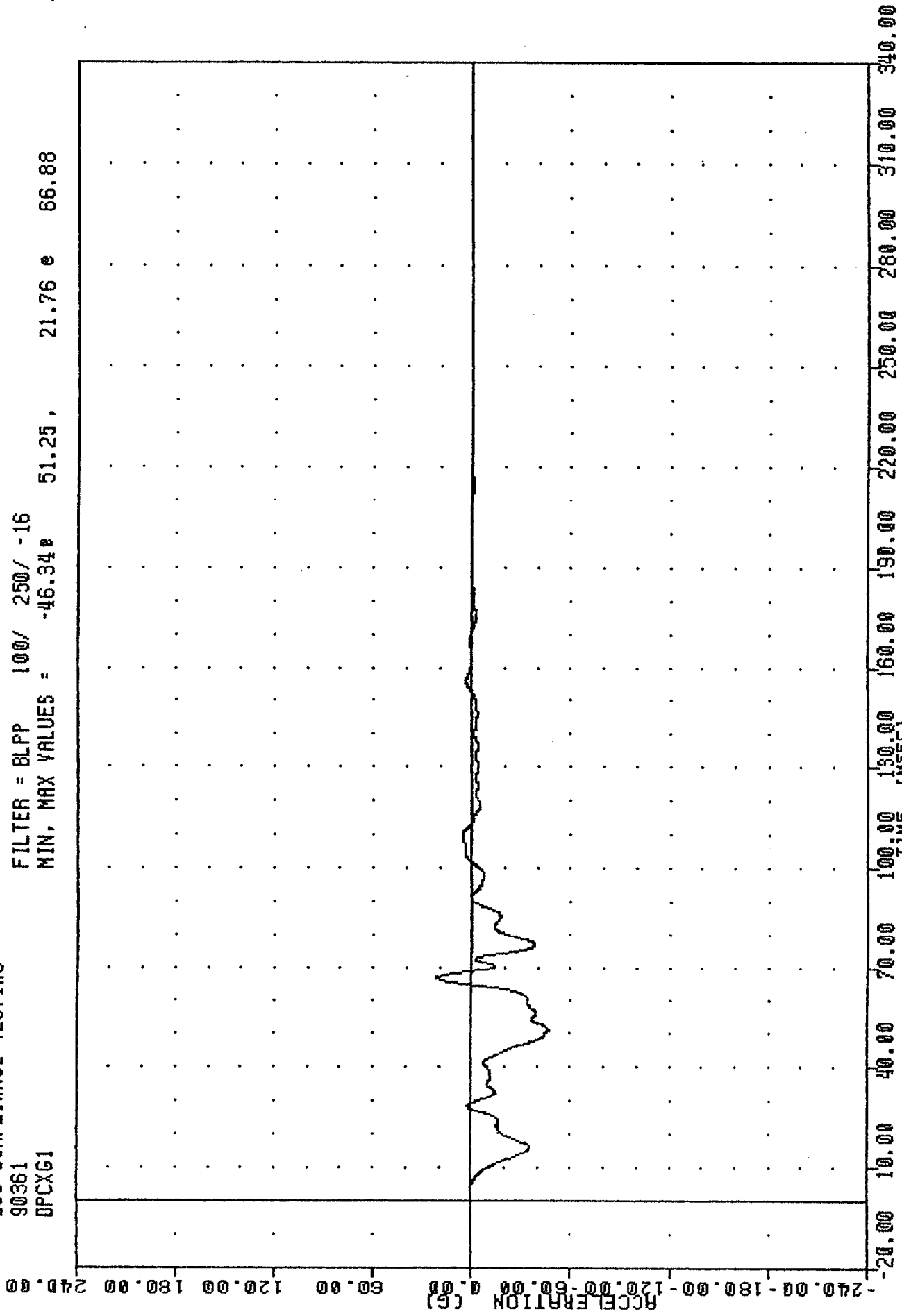
TRC , 901227
208 COMPLIANCE TESTING
90361
BCLXG1

FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -58.48 43.88, 49.78 61.00



TAC , 901227
 200 COMPLIANCE TESTING
 90361
 DPCXG1

FILTER = BLPP 100/ 250/ -16
 MIN, MAX VALUES = -46.34 51.25, 21.76 66.88



1991 BMW 318IS INTO FLAT FRONTAL BARRIER
 INSTRUMENT PANEL CENTER X-AXIS ACCELERATION